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RAPID TRANSIT

IN SAN FRANCISCO

A REPORT

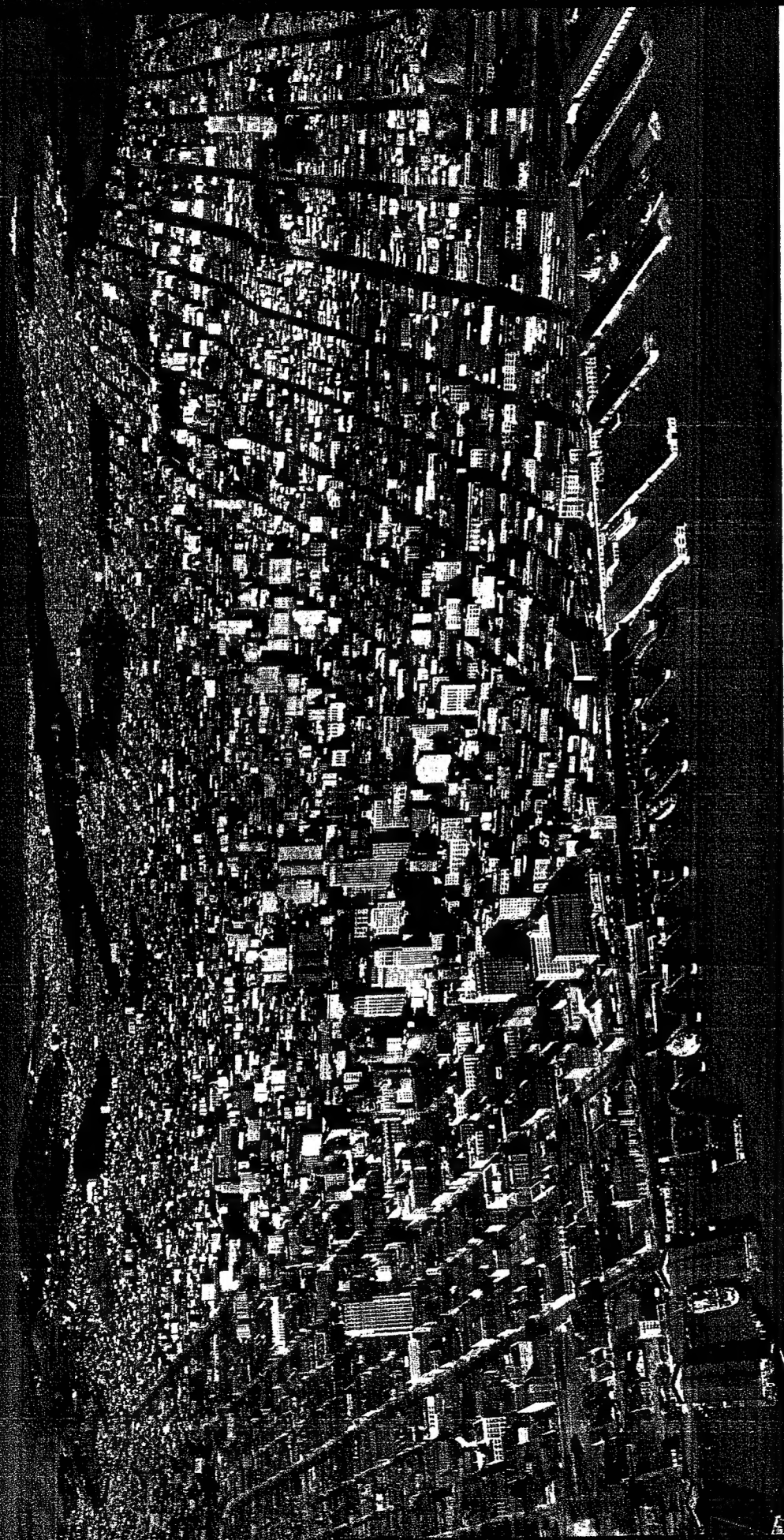
BY

THE

COMMISSION

PUBLIC UTILITIES COMMISSION
SAN FRANCISCO

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LOOKING WESTERLY OVER DOWNTOWN AREA AND NORTHERLY SECTIONS OF SAN FRANCISCO. MISSION AND POTRERO DISTRICTS ARE TO THE LEFT OUTSIDE THE PICTURE. CONGESTED AREA NORTH OF MARKET STREET IS CLEARLY SHOWN.

RAPID TRANSIT for SAN FRANCISCO



A REPORT
Rendered in May, 1936, to the
San Francisco Public Utilities Commission



LEWIS F. BYINGTON
President

GEORGE FILMER
Vice-President

JOHN P. MURPHY
Commissioner

JOHN H. McCALLUM
Commissioner

JOHN P. McLAUGHLIN
Commissioner

EDWARD G. CAHILL
Manager of Utilities

PAUL J. OST
Chief Electrical Engineer

ROBERT RIDGWAY

ALFRED BRAHDY
Consulting Engineers

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Cahill, Edward G.

Rapid transit for San
Francisco : a report
1936.

FOREWORD

The Public Utilities Commission of San Francisco, looking to the future growth and industrial security of the municipality, has had prepared by its Manager of Utilities, Mr. E. G. Cahill, and the engineers associated with him in public service, the attached report on the rapid transit needs of San Francisco. The data contained in the report and the recommendations made therein have had the most careful consideration of the members of the Commission, as has the question of cost, the resulting benefits from rapid means of transportation and the necessity for immediate action owing to the construction of the bay bridges with the resultant great increase in the tide of traffic. The Commission heartily endorses the recommendations contained in the said report.

It is vitally necessary for the welfare of San Francisco, in order to build up its industries and to stimulate its growth in population and in order to prevent industry and population turning away from San Francisco, with its wonderful natural advantages, to seek elsewhere locations offering more inducements through rapid transportation for expansion and development, that we seize the present opportunity to construct a rapid transit system which can handle expeditiously and efficiently our present congested traffic as well as the increased traffic which the completion of the bridges and the opening of the exposition will soon bring to our gates. The experience of New York City and other prosperous communities has proven that passenger travel must have quick access to business and industrial centers and rapid communication with the residential and suburban districts of the city.

The growth and prosperity of a nation, and of its cities and agricultural districts, rests primarily upon its great transportation systems, necessarily sustained and preserved, however, by the sturdy and patriotic character of its citizenship and the security given to life and property under a well organized and respected constitutional government.

New York City, through operation of its subways, has become one of the great cities of the world. The business property, contiguous to the subways, has almost doubled in value since their construction and its residential districts have shown remarkable expansion. San Francisco with its romantic and historical appeal and its beauty and charm of location is unrivalled among the cities of America. Its wealth and population will continue to expand and rest upon a sure foundation if we prepare for the future.

The accompanying report of our engineers shows that the construction of rapid transit subways will greatly shorten the running time between outlying residential and business districts; increase value of business and residential districts; add to our population by building up districts whose growth has been retarded by reason of slow transportation; furnish rapid and convenient service to the Bay Bridge terminals and between the financial, manufacturing and residential districts; and also supply the initial link for improved service to the peninsula communities.

It will more conveniently bring to the student easy access to our schools and universities and for all our people render more accessible our parks and recreation grounds, our bay and ocean shores, our homes and workshops.

In fact rapid transportation is the great requirement of modern industrial and civic growth, a transportation now made available on land by stream lined trains and automobiles moving over well paved highways, through the air and over the seas by aeroplane and fast driven vessels, and, of necessity, in cities by subways. The municipalities which most efficiently supply this transportation are the ones of marked industrial growth and which best conserve the well being and happiness of their citizens.

The future growth of San Francisco demands that if we are ever going to supply this need now is the time to move forward. Delay will but allow other localities to take advantage of the resulting good brought to the bay region by the completion of our bay bridges and our Golden Gate International Exposition. It is the best of economy and good judgment to act now. Delay may give the advantage to other communities.

Lewis F. Bingham

President,
San Francisco Public Utilities Commission.

RAPI

To the Honorable
The Public Utilities
City and County
Gentlemen:

At your direction
the subject of rapid

The data of
Paul J. Ost, your
way since its
transportation
electrical engine

Limited time
and structural
works, and John
of the city engineer
assistant. Both
Report.

All of the
experience which

I feel that
Ridgway and Mr.
to see conditions
local problems as

In the year
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traffic will increase
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The combined
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The problem
compared with the
any consideration.

The above figure
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daily load west of
added the number
are moved in the

Market Street
laid out on the
spaced gore corner

RAPID TRANSIT FOR SAN FRANCISCO

A Report Rendered in May, 1936, to the
San Francisco Public Utilities Commission



To the Honorable
The Public Utilities Commission of the
City and County of San Francisco.
Gentlemen:

May 25, 1936.

At your direction, I have had prepared and submit the following report dealing with the subject of rapid transit in San Francisco.

The data on which this report has been based have been prepared under the direction of Paul J. Ost, your chief electrical engineer, who has been connected with the Municipal Railway since its inception and who was in charge of street railway valuations and local transportation reports made by the City Engineer in 1921, 1929 and 1931. L. M. Perrin, electrical engineer, has been his chief assistant.

Limited time and funds would not permit of organizing a new staff to prepare designs and structural estimates. Through the cooperation of W. H. Worden, director of public works, and John J. Casey, city engineer, it was possible to have this work done in the office of the city engineer by W. H. Ohmen, chief designing engineer, and A. V. Bowhay, his assistant. Both of these men had been similarly engaged on the 1931 Rapid Transit Report.

All of the men named have had not only general local experience, but special experience which has qualified them to plan wisely.

I feel that your Commission was particularly fortunate in securing the services of Mr. Ridgway and Mr. Brahdry who brought to the work a wealth of experience and the ability to see conditions more broadly than men who may have been so closely associated with local problems as to lose some perspective.

In the year 1929, which may be considered a normal traffic year, the ferries transported 35,847,450 foot passengers between the East Bay cities and San Francisco. In the same year the street railways of San Francisco carried 355,969,298 passengers, or ten times as many. While since 1929 there has been a sharp decline in the number of passengers carried by both classes of service, the ratio remains about the same and it is probable that local traffic will increase at a faster rate in the future. Chief Engineer C. H. Purcell of the San Francisco-Oakland Bay Bridge, estimates that in the initial year 32,000,000 passengers will be carried by rail across the bridge and that this number will increase to 40,000,000 by the year 1950. As about half the bridge passengers will walk to their San Francisco destinations, it is conservative to say that twenty local passengers will be carried on the street cars in the City for each street car passenger who enters or leaves the bridge terminal. Figure 1 shows the number of passengers using East Bay electric trains and San Francisco street cars, for the years 1919 to 1935 inclusive.

The combined boat and train foot passengers from Marin County and the Peninsula during 1929 did not exceed 12,000,000.

The problem of providing transportation for persons from out of town is insignificant compared with that of handling San Francisco's local traffic, and therefore requires secondary consideration.

The above figure for street railway traffic indicates that the street railways handle 1,000,000 passengers on week days. Market Street carries more than 200,000 of these. The daily load west of Sixth Street is 150,000 as determined by traffic count. To these must be added the number using lines branching off east of Sixth Street. More than 30,000 of these are moved in the evening rush hour.

Market Street runs diagonally south and west while the streets to the north of it are laid out on the cardinal points of the compass in a grid system meeting it in irregularly spaced gore corners. On the south side the system is rectangular with blocks paralleling

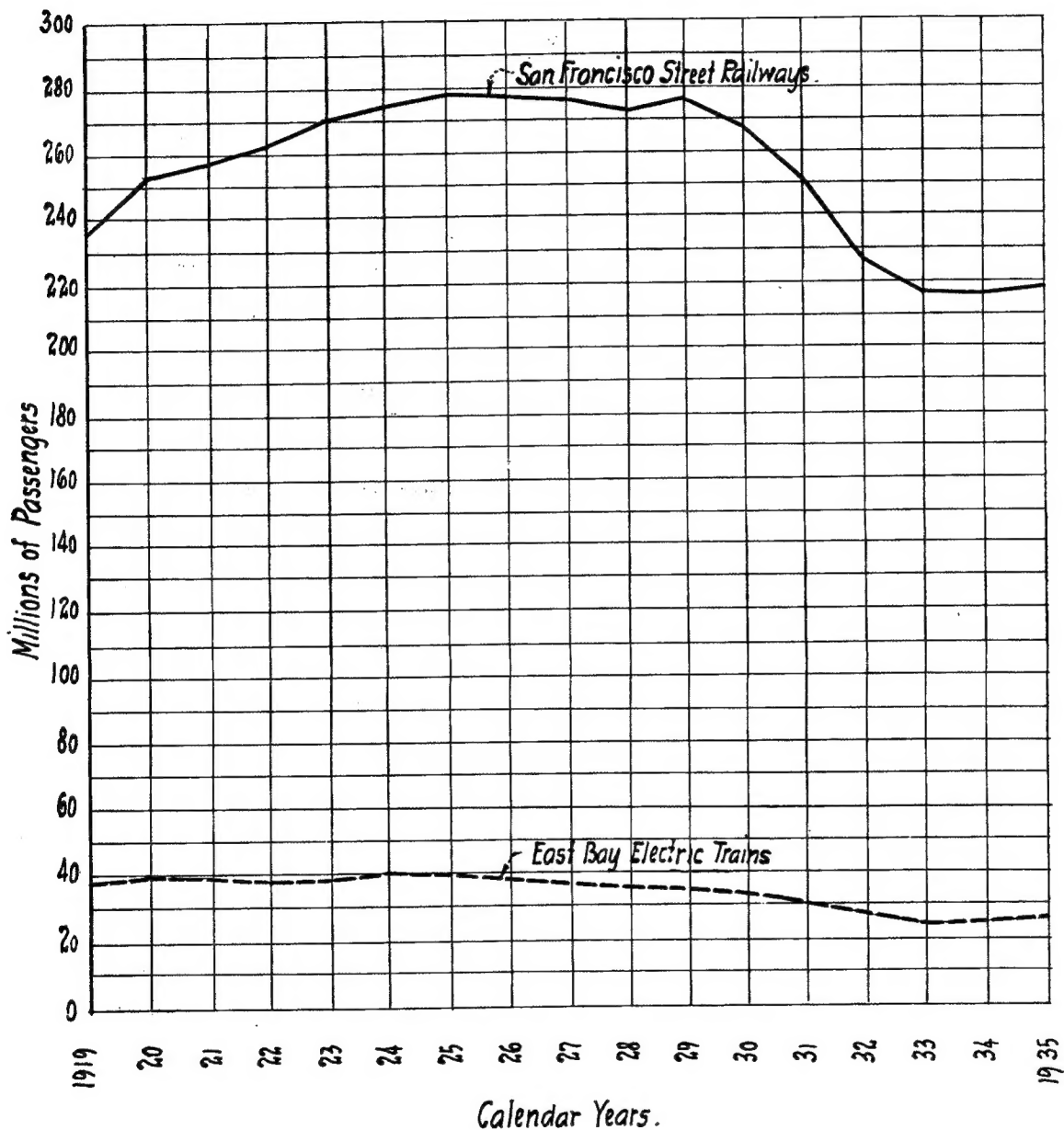


FIGURE 1
COMPARISON OF SAN FRANCISCO LOCAL AND EAST BAY
SUBURBAN PASSENGERS

Transfer passengers are not included.

Market Street. W
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crossings of downt

The condition
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Street street car
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and the California

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Crosstown traffic i
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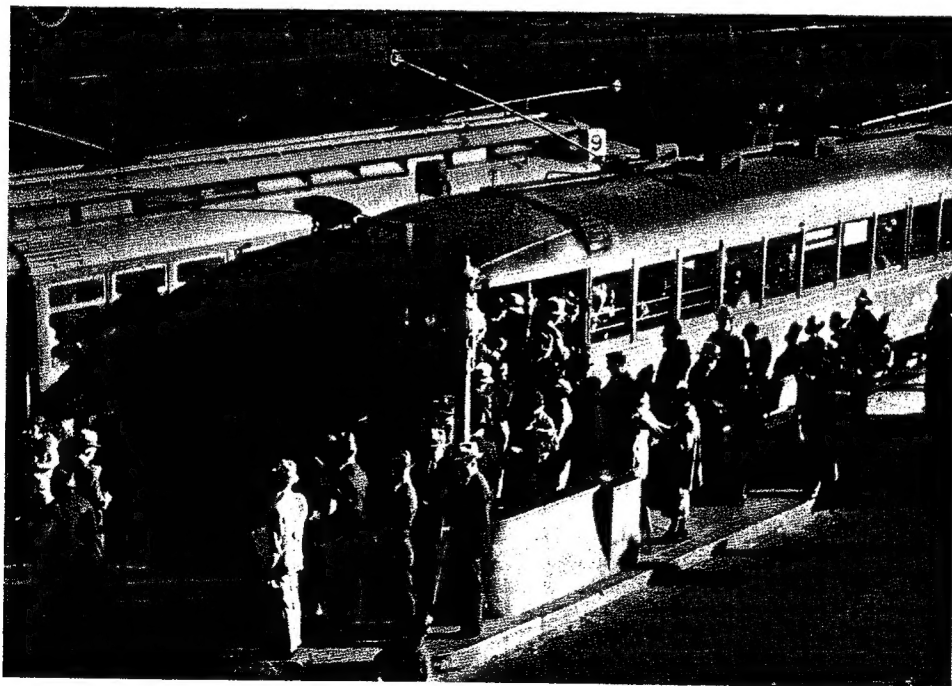
Market Street. With the irregular spacing of the gore corners on the north side of Market Street and many blocks 825 feet long on the south side, there are only three or four usable crossings of downtown Market Street.

The condition described makes Market Street a trough cutting diagonally across the City, into which pours all kinds of traffic. While it has a width of 120 feet, its capacity through the downtown area is taxed to the limit, resulting in acute congestion during the evening rush. It is conservative to say that not less than sixty-five per cent of the Market Street street car passengers are bound for destinations north of Market Street. The character of the district north of Market is distinctly different from that to the south. In general, the retail and financial districts, with a resulting large day-time population are on the north, with the wholesale and industrial districts to the south. [The frontispiece, looking westerly over the City, clearly shows the difference between the two sides of the street and the street pattern described.]

Local transportation is furnished by three systems, the Market Street Railway with 232 miles, electric, cable and bus; the Municipal Railway with 96 miles, electric and bus; and the California Street Cable Railroad with 11 miles, all cable operated.

The plan of the streets and the fact that the business district is in one corner of the City, rather than in the center as is usually the case, necessitates the routing of a large number of street car lines onto Market Street. After reaching Market Street it is impracticable to turn them back, consequently they continue to the loop in front of the ferry terminal at the eastern end of the street. As this traffic cannot be handled on two tracks, the Market Street Railway has a pair of tracks in the center of the street, and the Municipal Railway one track on each side of them. Dual ownership and the downtown requirements have resulted in the use of four tracks for the entire length of the street although for the westerly mile, one pair could carry the cars of both systems.

As already stated there are only three or four satisfactory crossings on Market Street. Crosstown traffic is concentrated at these crossings creating long delays in the movement of all traffic on both Market Street and the cross streets.



AT ALL MARKET STREET LOADING ZONES WEST OF FIFTH STREET PATRONS MUST USUALLY WAIT TO SECURE EVEN CROWDED STANDING ROOM.

24
19 35

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT

The four tracks on Market Street restrict its use by automobiles and divert some travel into the streets to the north thereby adding to their congestion. The restricted space for automobile travel between the curb and the outside tracks causes automobiles to encroach on the tracks to such an extent as to slow street car traffic. The combined result of all these conditions has made it necessary to establish an evening rush hour schedule of less than 4 miles an hour on some parts of Market Street. In some sections it is now possible to walk faster than the cars travel. Even with this slow schedule, minor accidents or unusual occurrences create traffic interruptions causing street cars to leave the downtown area from 5 to 10 minutes behind schedule. Three or four miles can be traveled outside of the congested area in the same time it takes to move one mile downtown.

The problem to be solved is how to decrease street car congestion in the downtown district, provide more capacity for automobile traffic, and materially shorten the travelling time to places of residence in San Francisco. It is also necessary to furnish transportation to the bridge terminal.

THE NECESSITY FOR RAPID TRANSIT.

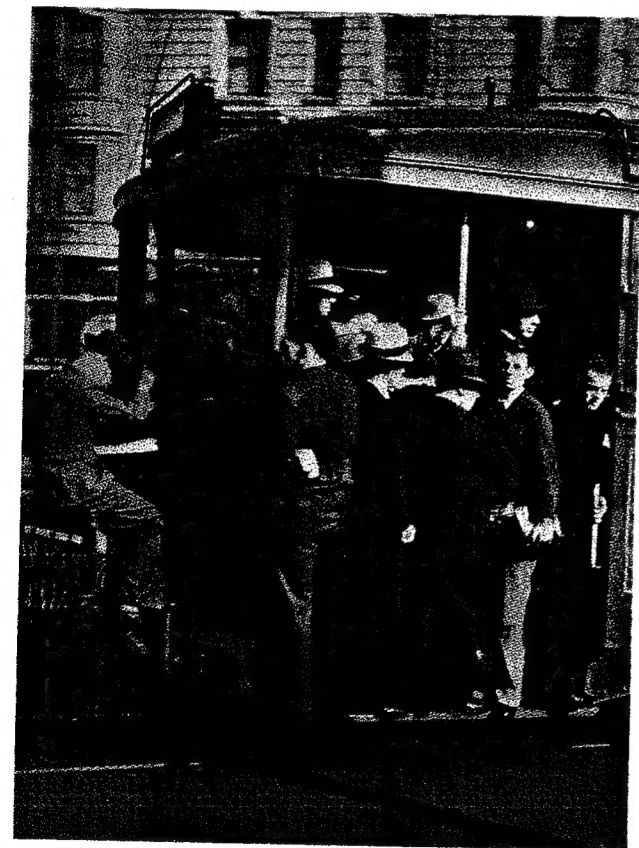
The time required to reach some of the most desirable residence districts from the financial district is now equal to that required to travel to Redwood City or Palo Alto on the Peninsula, and to many points in the East Bay Area.

The bridge now under construction across the Bay of San Francisco to Oakland, which

is expected to be open for interurban trains in 1938, will supplant the ferry boats now connecting San Francisco with the suburban service to the East Bay communities. The use of the bridge will decrease the present running time by as much as 12 minutes and greatly increase the comfort and convenience of transbay travel. Figure 2 shows traveling time from Third and Market Streets to East Bay points over the bridge and to San Francisco residential districts with the present street car service.

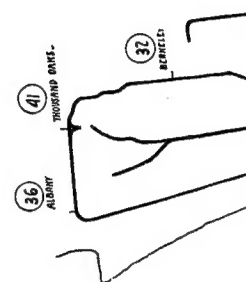
The location selected for the San Francisco train terminal is 1500 feet closer to the San Francisco interurban passenger load center than the present ferries. This will encourage many more people to walk from the transbay service to their places of business, resulting in a monthly saving in the expenditure for transportation.

In the minds of transportation and real estate experts there is no question that many thousand San Franciscans



THEY BECOME ACCUSTOMED TO READING THE NEWS WHILE RIDING IN THE RUMBLE SEAT.

will consider moving to East Bay cities. The Postmaster of San Francisco states that the number of changes in local addresses during a year approximates 190,000, equivalent to more



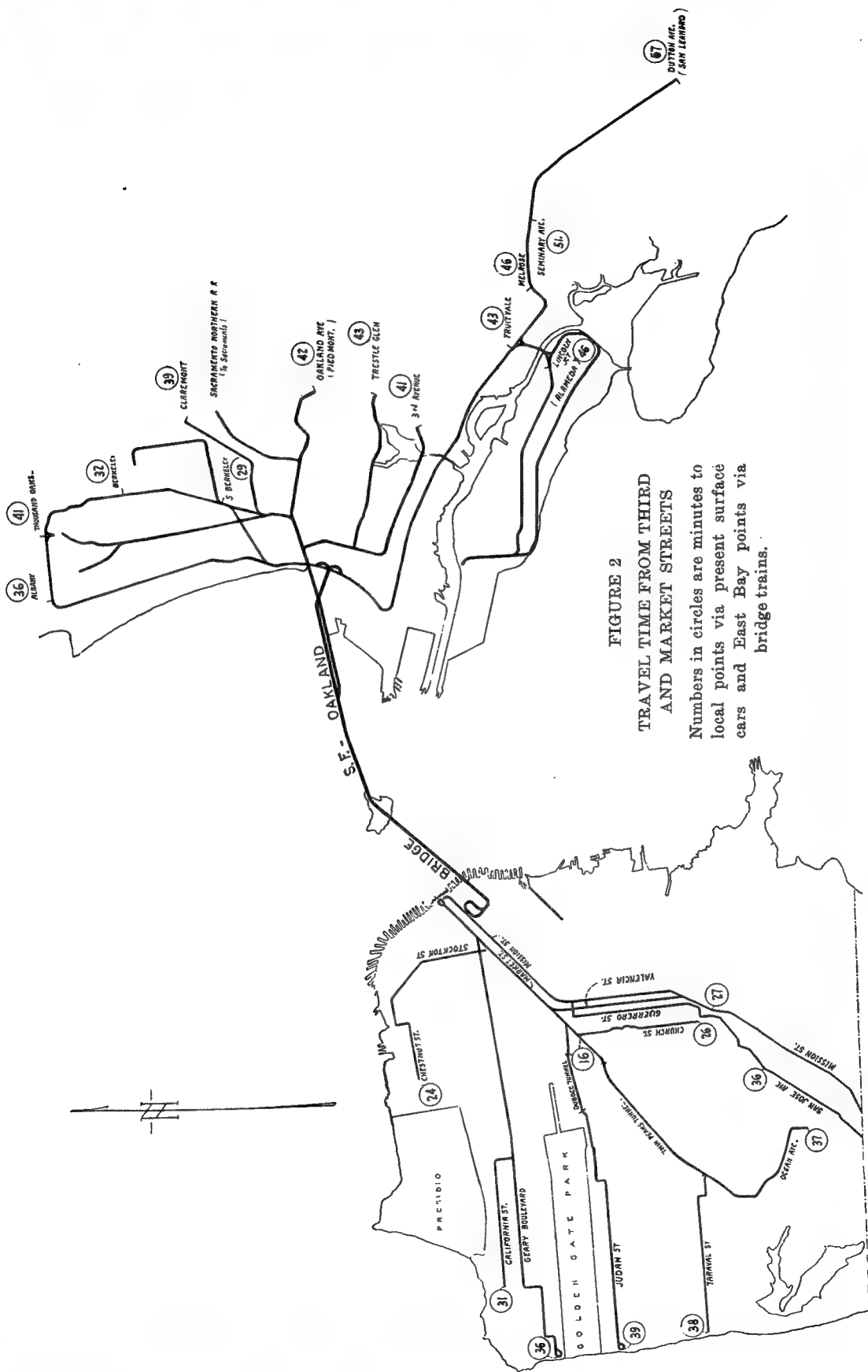


FIGURE 2
TRAVEL TIME FROM THIRD
AND MARKET STREETS
 Numbers in circles are minutes to
 local points via present surface
 cars and East Bay points via
 bridge trains.

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT

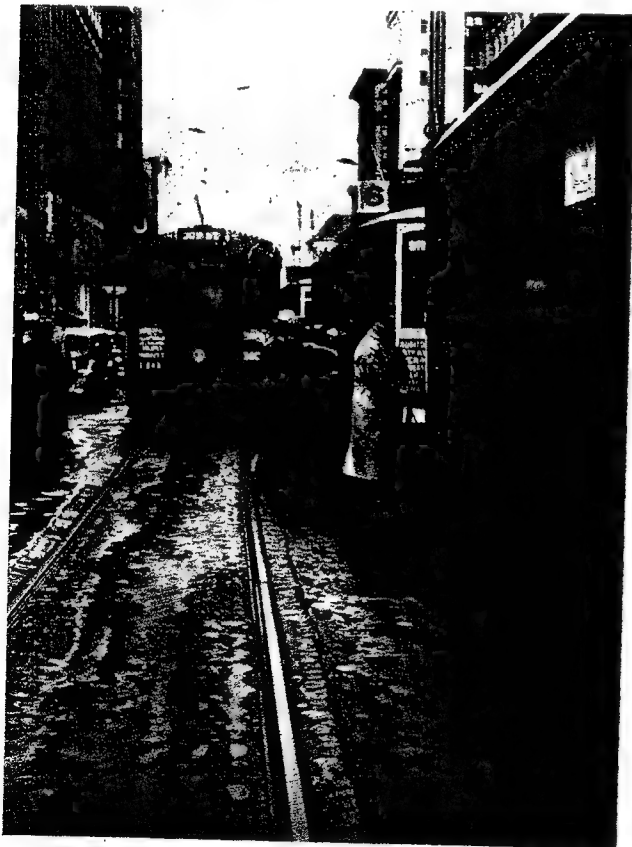
than one-quarter of the total population, which indicates the tendency for San Franciscans to shift their places of abode.

San Francisco has always been the metropolis of the Bay district but if local transportation service is not made to compare favorably in time and comfort with train service over the bridge, and causes the loss of any considerable number of its people, it will not be long before the population of the two sides of the Bay will be equalized. It has been estimated that without better local transportation, San Francisco may in the next few years lose as many as 100,000 people. San Francisco has so far maintained its supremacy because interurban transportation has been equally slow or inconvenient in every direction. With the establishment of fast and comfortable train service to the east over the Bay, this state of equilibrium will cease unless local transportation to the west and south is likewise improved. Figures 3 and 4 show the time to travel from Third and Market Streets, and California and Montgomery Streets respectively, to East Bay destinations by bridge trains and to San Francisco destinations by rapid transit. To maintain its position of preeminence the population in all directions from San Francisco's financial center must maintain a balance.

The analogy of San Francisco's position to that of Manhattan, New York, is striking. Both are situated on the tip of a peninsula and both are surrounded on three sides by suburban districts. New York has maintained its supremacy by providing equal rapid transit facilities to the east, west and north which has resulted in a balanced population on all sides of Manhattan. New York is not concerned if a million people establish themselves in New Jersey because it is certain that another million will go east to Brooklyn,

and a third million north to the Bronx. This has made Manhattan the crossroads in a metropolitan center of 10,000,000 people. During the last ten years the actual population of Manhattan itself has decreased by half a million while its property values have doubled and the daytime population has tremendously increased,—all because of rapid transit equally fast in every direction.

A study of the development of any metropolitan area demonstrates conclusively that where transportation facilities have not been furnished on a balanced basis an unbalanced development and growth has inevitably taken place. If San Francisco does not take the necessary steps to provide rapid and comfortable transportation into the outlying districts of San Francisco and the Peninsula it will lose not only large numbers of its present population, but what is of equal importance it will not, as it should, gain the advantages that will come from the increased population that



PASSENGERS BOARDING THE CARS ON THE INNER TRACKS ON MARKET STREET SERIOUSLY DELAY THE CARS ON THE OUTER TRACKS.



A MOMENT

will inevitably Twin Peaks Tunnel unproductive fraction of the City and has already

Assume the facilities for this Oakland Bridge Francisco. It is with greater freedom find that they can be taken directly East Bay transponders of our side of the Bay.

Thus we run obtain the benefit development of

In consideration as to whether service the debt ensue, the losses of our present transportation as to whether sented the question

One reason for years is that the factory service time compared to the



A MOMENT'S INTERRUPTION ON MARKET STREET CAUSES A JAM OF CARS
RESULTING IN LONG DELAYS.

will inevitably come into the San Francisco Bay territory. Prior to the completion of the Twin Peaks Tunnel, San Francisco had west of Twin Peaks, a large area of acreage virtually unproductive from a tax revenue standpoint. Today that area comprises a very important section of the City. The increase in the assessed valuation of the property has been tremendous and has already paid more than the cost of the Twin Peaks Tunnel.

Assume that we do not make the necessary preparations to furnish transportation facilities for this side of the Bay that will be comparable with those which the San Francisco-Oakland Bridge will furnish. In such an event many people will unquestionably leave San Francisco. It is a well known fact that the people of San Francisco have a habit of moving with greater frequency than the people of some other sections. If San Francisco residents find that they can get on a rapidly moving train with a seat furnished for each passenger and be taken directly to homes across the Bay, many of them, with the superior facilities of the East Bay transportation system available, will not be content to hang onto the steps and fenders of our street cars, as they do at the present time, but will move to the east side of the Bay.

Thus we run the danger of losing not only present tax revenues, but may fail also to obtain the benefits arising out of increased property values that will surely follow the development of a proper system of rapid transportation.

In considering the matter of cost we should not concern ourselves only with the question as to whether or not the revenue derived as a result of an improved system will service the debt made necessary thereby. We must balance against any cost which might ensue, the losses in property values and tax revenue, if we do not make some improvement of our present transportation system. In other words, we have before us not only the question as to whether we can afford to make these improvements, but there is likewise presented the question, can we afford not to make them?

One reason San Francisco has maintained its superiority and population through the years is that the local street car lines have rendered a faster and in general a more satisfactory service than that given to suburban areas, and this relation must be maintained as compared to the improved service now under construction to the East Bay.

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT

The largest unbuilt portion of San Francisco lies west and south of Twin Peaks, where property is very desirable but under present conditions is as remote in time as some of the suburban territory. With proper rapid transit lines this area may house many thousands of people in attractive homes and by its location to the west it will counteract the pull to the east created by the bridge.

The population on the Peninsula will without question grow at a more rapid rate than that in Marin County and it behooves San Francisco to encourage in every way possible the growth of the Peninsula cities as the interest of San Francisco and San Mateo Counties are closely linked.

Because traffic increases at a compound rate as compared to population growth, surface travel in a large city quickly reaches a point of saturation producing inefficiency, dissatisfaction, and crowding with its attendant discomfort.

While the distances in San Francisco are not great, the time of travel is mounting very rapidly and downtown street congestion is becoming a burden to everyone. Some of the traffic congestion and crowding now experienced with the present system is shown by the photographs which are included in this report.

Rapid transit is the only method so far devised for eliminating slow travel and relieving surface congestion; high speed rail lines in effect move the outlying residential districts closer to the heart of the City. San Francisco must secure a saving in time in street car transportation which more than offsets that accruing to the East Bay cities through rail service over the bridge, or suffer a loss of population and property values. The area of San Francisco is sufficient to house under comfortable and healthful conditions, between three and four times its present population.

The bridge will be ready for rail service in 1938 and even now it is impossible to place any portion of a rapid transit system in service in San Francisco before that time. Therefore immediate action is necessary because after people have taken up residence elsewhere it will be difficult to secure their return. The vigorous prosecution of a definite rapid



POST AND MARKET STREETS SHOWING SATURATION OF STREET CAR TRAFFIC ON LOWER MARKET STREET.

transit program
San Francisco as to
population.

To meet the
a system which
maximum results.

Rapid transit
It is evidently
our streets at
vehicular traffic
the surface or
Both elevated

years so the
elevated rapid
given to the
property. Elevated
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A survey has
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risen more than
of 53rd Street
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Both New
Philadelphia originated
town; the newer
but is making plans

In embarking
ment in which the
form of transportation

An elevated
in San Francisco
high viaducts and
Subway construction
for present and
some stations made
of the subway and
underground system

To meet the
construction in connection
service between
Richmond, Sunset
feeders will accelerate
Twin Peaks Tunnel
tunnel routes into
these lines.

Figures 3 and 4
destinations and
street railway lines
Third and Market

transit program will hold many who would otherwise leave the City. It will maintain San Francisco as the metropolitan center, increase property values, and encourage increase of population.

RAPID TRANSIT SYSTEM.

To meet the problem and necessity for rapid transit just stated it is imperative to plan a system which will meet the immediate conditions with a minimum expenditure and maximum results, and one adaptable to future extension when required.

Rapid transit connotes separation of public transportation from general surface traffic. It is evidently impossible to secure a high speed private right of way down the middle of our streets at surface grade and it is also impossible to consider moving pedestrian and vehicular traffic from the surface. Therefore rapid transit must be either elevated above the surface or placed beneath.

Both elevated and subway rapid transit lines have been built and operated for many years so the advantages and disadvantages of both are well known. While the cost of elevated rapid transit is about one-third that of subway construction, consideration must be given to the heavy damages resulting from cutting off light, air, and access to the abutting property. Elevated structures of all kinds depreciate the property facing the street on which they run to such an extent as to make them inadvisable for use in San Francisco where land area suitable for business purposes is very limited.

A survey just completed by the New York Board of Transportation finds that the assessed value of property adjacent to Sixth Avenue between 54th and 58th Streets, has risen more than 56 per cent in the ten years since the Interborough elevated structure north of 53rd Street was removed. That this increase in valuation is due to the removal of the elevated line is clearly shown by the fact that the value of property on Sixth Avenue and for 100 feet on the side streets, increased 100 per cent. In the zone between 100 and 200 feet from the old structure, the appreciation in value was 34 per cent, and in the zone between 200 and 300 feet from the elevated line the increase was 24 per cent. These percentages were derived after making due allowance for a normal increase in value.

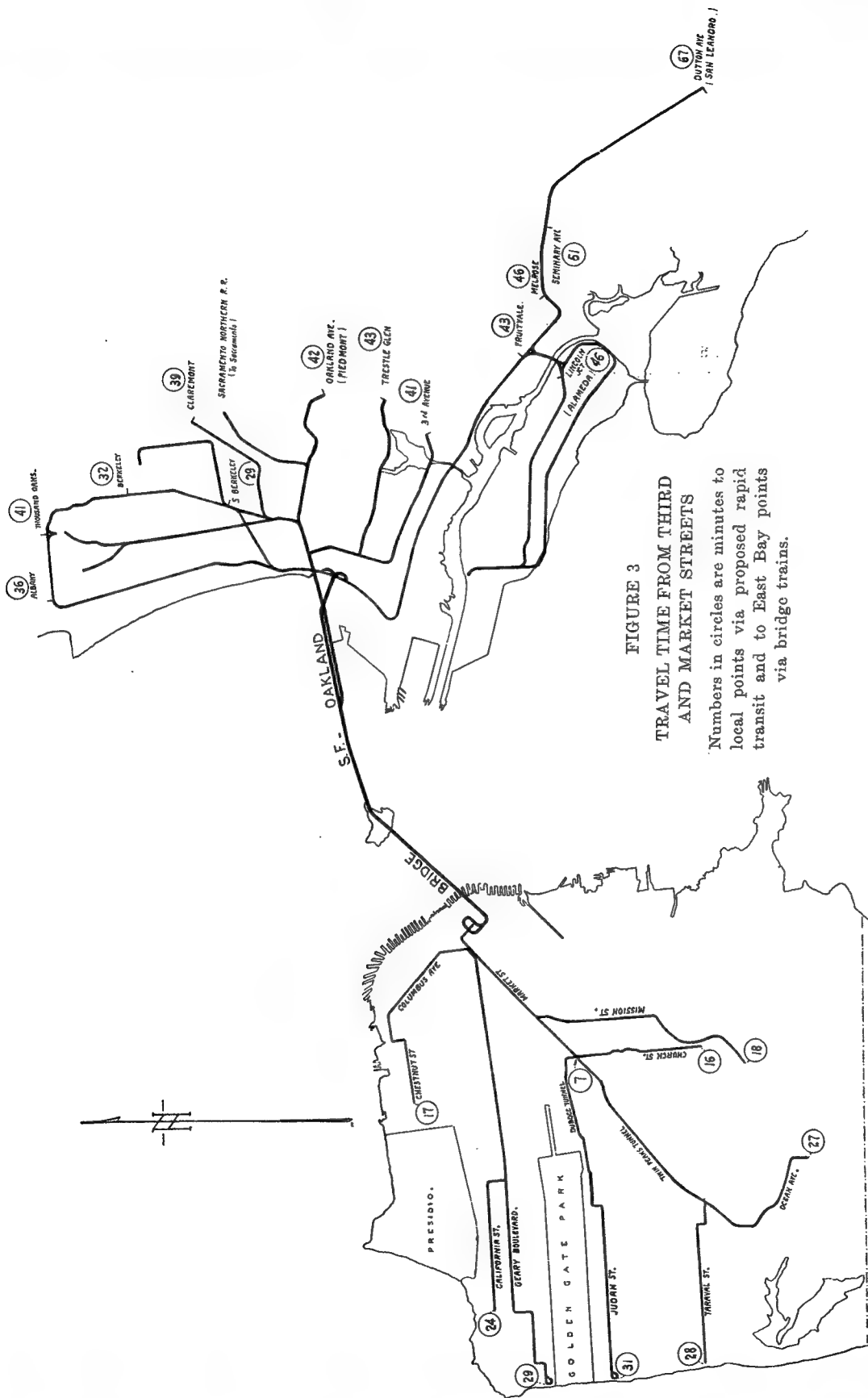
Both New York and Boston are now replacing elevated structures with subways. Philadelphia originally constructed elevated in the outlying districts with subway downtown; the newer extensions have been all subway. Chicago has elevated tracks downtown but is making plans to construct subways.

In embarking on a rapid transit program San Francisco is making a permanent investment in which the experience of others should be used as a guide. It must also adopt a form of transportation which can be extended to all parts of the City.

An elevated structure must closely follow the contour of the ground. The many hills in San Francisco would make elevated construction difficult and expensive requiring both high viaducts and tunnels to keep within the maximum grade permitting rapid transit. Subway construction does not have to follow the surface grades and all lines contemplated for present and future construction can be kept within reasonable grade limits, although some stations may be at a considerable depth. Many more reasons justifying the selection of the subway could be given. There is no question as to the advisability of building an underground system.

To meet the immediate necessity for rapid transit, three lines were selected for construction in congested portions of the City. These three lines will give greatly improved service between the downtown section and the North Beach, Marina, Western Addition, Richmond, Sunset, West of Twin Peaks and Mission Districts and by relatively short bus feeders will accelerate transportation as far south as the County line. The Sunset and Twin Peaks Tunnels already furnish a partial rapid transit service and by extending the tunnel routes into the subway additional time saving will be conferred on the patrons of these lines.

Figures 3 and 4 have been prepared to show the relative travel time to East Bay destinations and the outlying residential sections of San Francisco which will be served by street railway lines operating in the subways proposed. Figure 3 shows travel time from Third and Market Streets and Figure 4 from California and Montgomery Streets in the



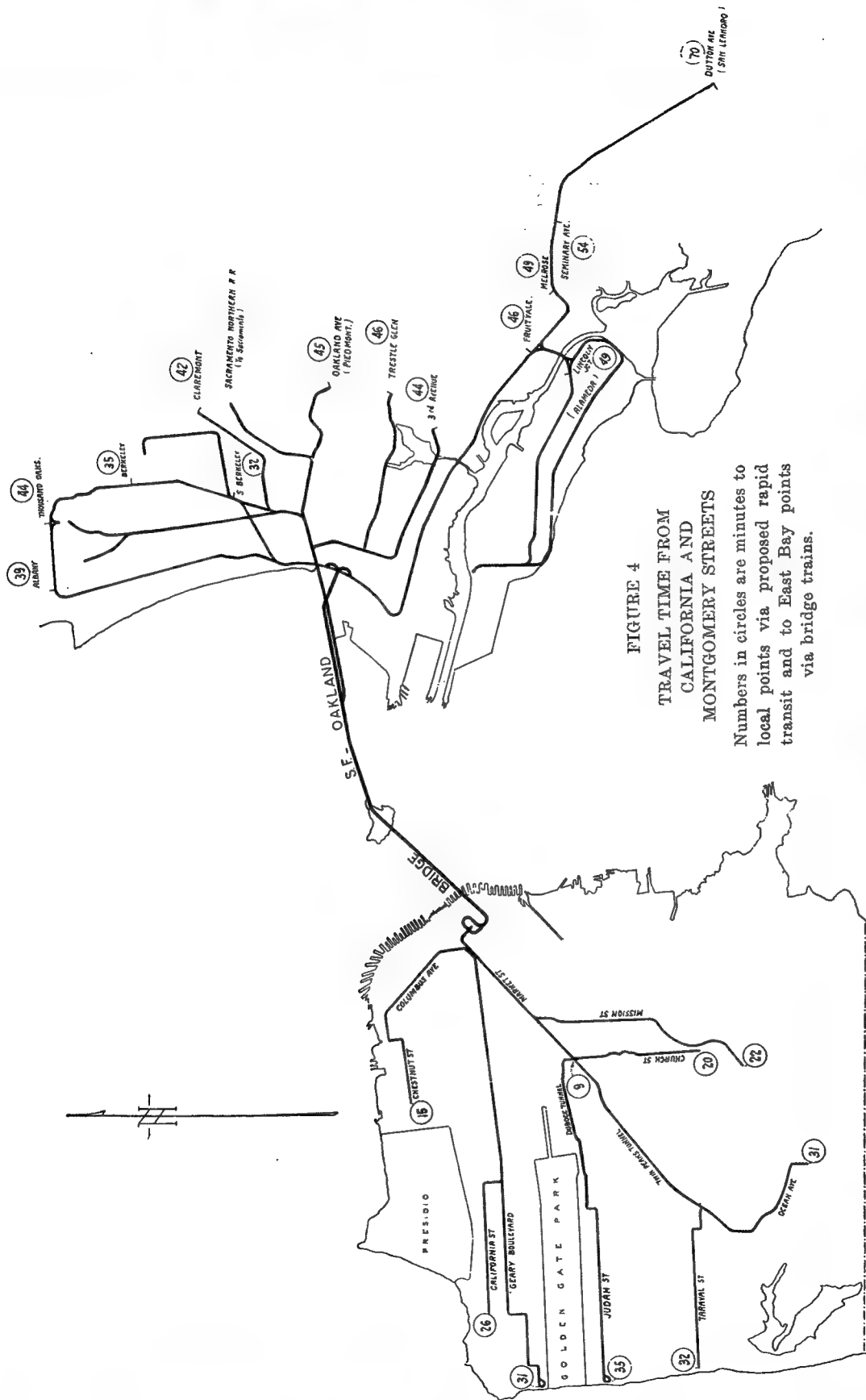
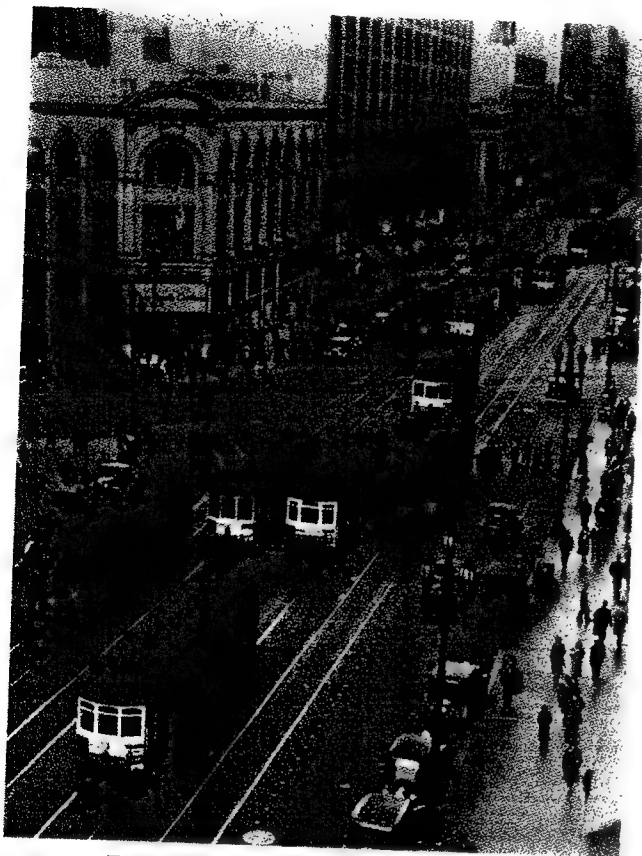


FIGURE 4
TRAVEL TIME FROM
CALIFORNIA AND
MONTGOMERY STREETS
Numbers in circles are minutes to
local points via proposed rapid
transit and to East Bay points
via bridge trains.

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT



EVENING TRAFFIC AT FOURTH AND MARKET STREETS.

outside the subway. Cars of a modified design can be purchased when traffic warrants or the existing equipment requires replacement.

The feasibility of permitting the Market Street Railway to use the subway under Market Street jointly with the Municipal Railway was carefully considered and abandoned because with the initial operation of a number of small units the capacity of this subway will be nearly absorbed with the routings proposed. Safety with high speed operation determines the space interval between units and fixes the maximum number of movements in a given time. To operate more than this maximum number sacrifices either speed or safety and both are essential to rapid transit. Greater capacity of the subway will be secured later by increasing the size of units, not the number.

The number of passengers per hour that can be moved past a given point is proportional to the number of cars. By sacrificing speed, the space between cars may be reduced with safety, producing maximum capacity at lowest speed. This condition now exists on lower Market Street.

A subway makes multiple unit or train operation possible which secures maximum capacity and speed with safety. Whereas a maximum of 13,000 passengers per hour can now be moved at a speed of 4 miles per hour on a surface track, up to 90,000 passengers can be hauled at over 17 miles per hour on a subway track.

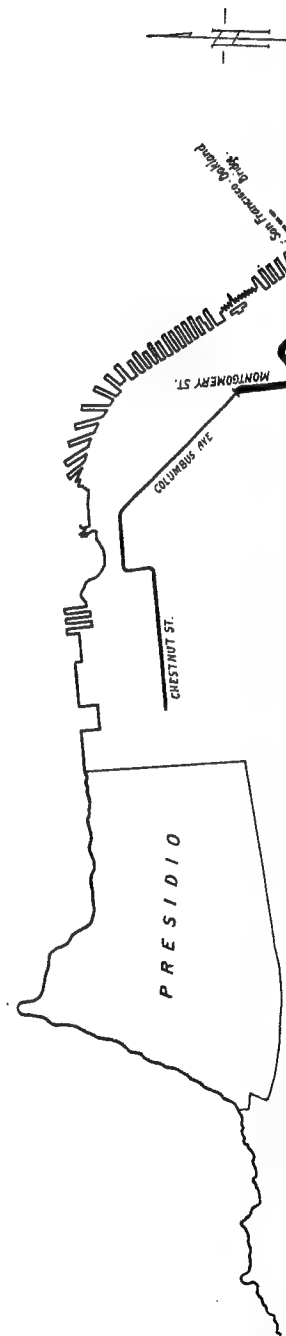
The lines proposed will fit into any probable ultimate scheme of rapid transit. Sufficient study of an extended rapid transit system has been made to insure this.

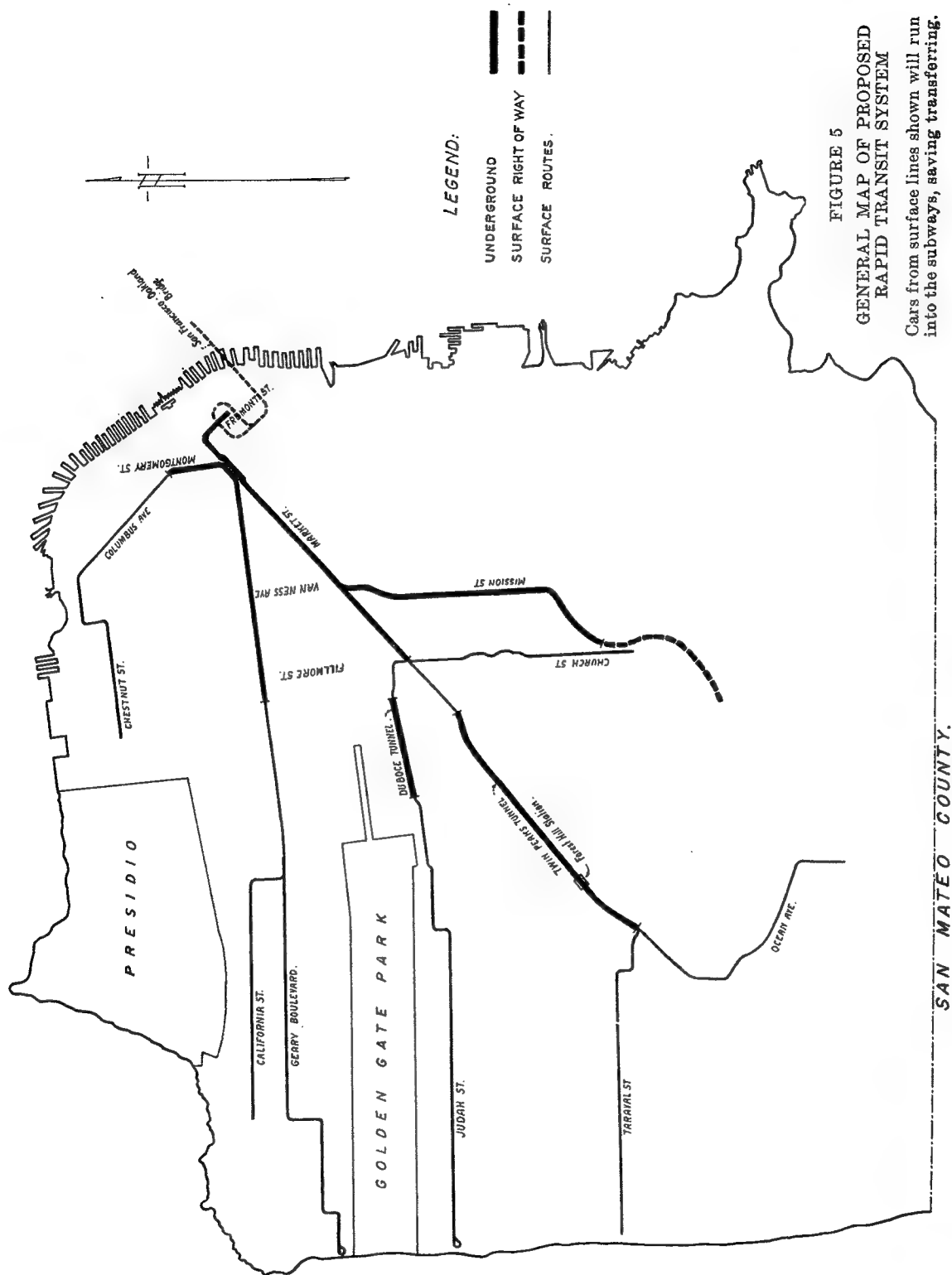
Your engineers have not been unmindful of the many plans and proposals submitted

financial district. To the bridge train time has been added an allowance for the time required to reach the bridge terminal station by the most direct route. No time which may be lost in waiting for either train or subway car has been included.

The Market Street subway will make it possible to abandon the outer tracks on that street west of Third and Kearny Streets. It is proposed that the Municipal Railway operate all subway service using its present street cars in all but the Mission Street subway, which, being an extension to the Municipal Railway route mileage, will require new equipment.

The density of travel at the present time does not warrant using conventional subway cars and the Municipal Railway cars can be modified at a small expense to make them suitable for use underground either singly or in multiple car trains. A very large expenditure for equipment will be saved and the present street car service will be continued





by individuals and organizations in an attempt to solve the problem. The prime object of the majority of these plans has been to care for passengers reaching San Francisco via the bridge. That this is secondary is shown in the opening paragraphs of this report. In most cases the suggestions submitted have been prepared without definite knowledge and without due regard to the expenditure and difficulties involved. Some of them have thought a union station should be the nucleus of the rapid transit system; others dwelt on the subject of through service from one suburban area to another with incidental local transportation; other plans have extended the outside tracks through the City with stops at a number of local stations.

After studying routes and costs it was deemed advisable to have the conclusions of the local engineers checked by nationally recognized authorities. For this purpose your Commission employed Robert Ridgway, retired chief engineer of the New York City Board of Transportation, and Alfred Brahdy, designing engineer of the same Board. Mr. Ridgway was one of the three engineers previously employed to advise on the location of the San Francisco-Oakland Bay Bridge, thus beside his national reputation as a builder of rapid transit, he had knowledge of local requirements. Mr. Brahdy, in addition to rapid transit engineering for the City of New York, had been associated with Mr. Ridgway in subway design for Chicago and Buenos Aires.

Their report, submitted to your Commission in July, 1935, has been included in the appendix to this report.

ROUTES PROPOSED.

The following program approved by the consultants, is therefore submitted with confidence that it is the best method of meeting San Francisco's present and future requirements.

1. A line on Market Street from Church Street east to Fremont Street, with an extension under Fremont to the Bay Bridge Terminal.
2. A line through the Mission District from the south end of Bernal Cut to Mission Street and under Mission Street to a connection with the Market Street line at Van Ness Avenue.
3. A line under Geary Street from Hamilton Square east to Market Street, under Market Street to Montgomery Street, and north on Montgomery Street to Columbus Avenue.

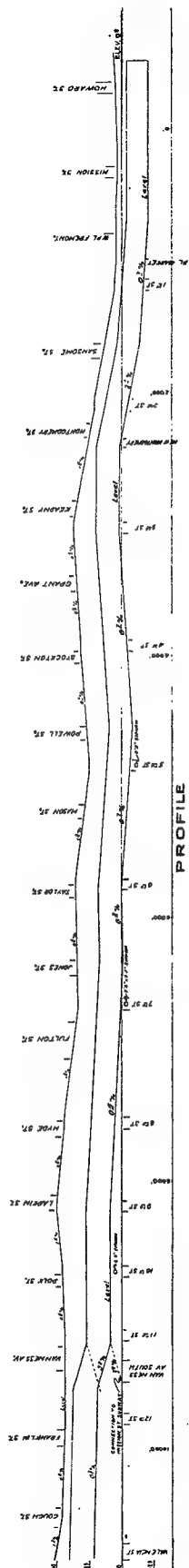
The total length of these three lines, which are shown on Figure 5, is $8\frac{1}{2}$ route miles.

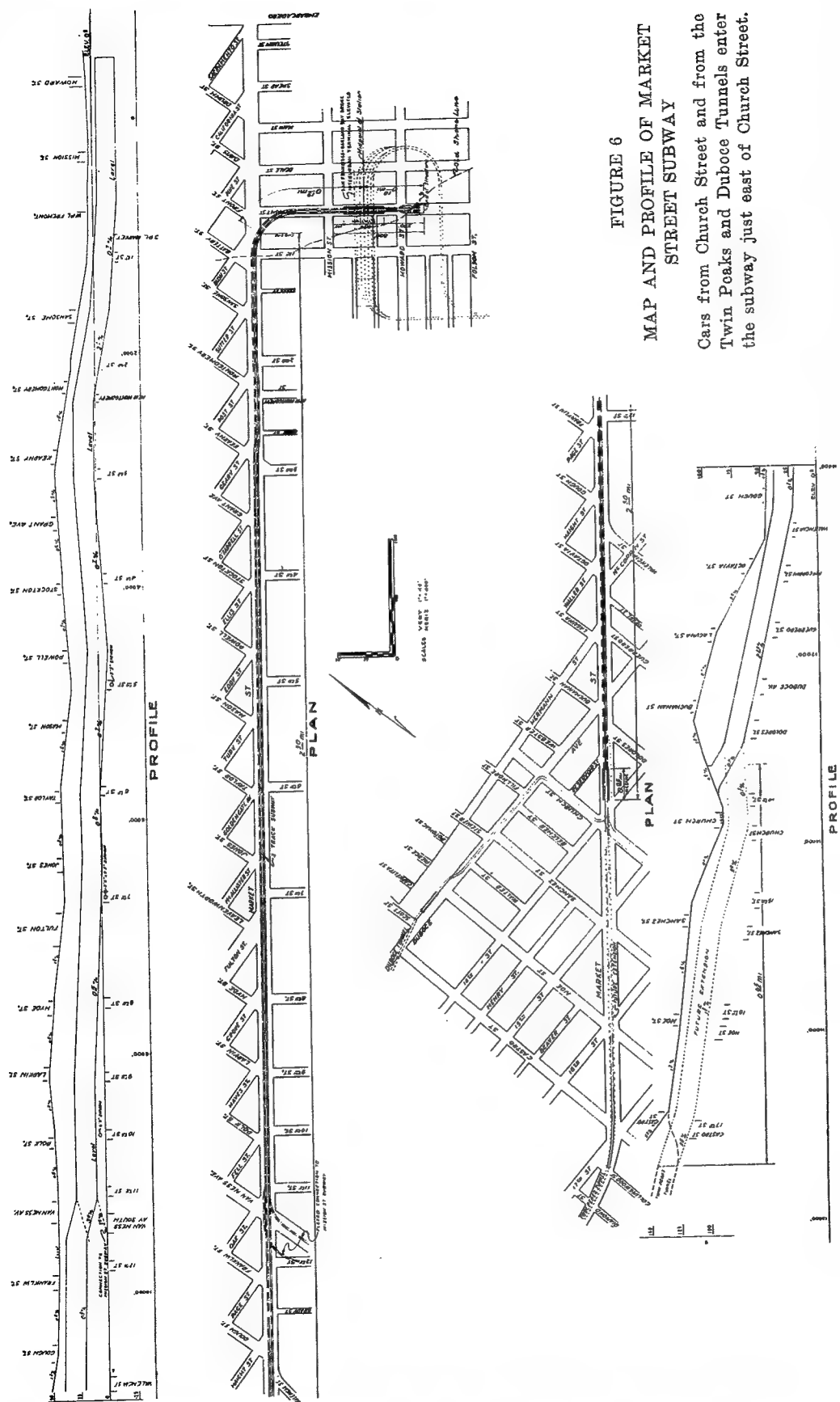
Market Street Route—Market Street was selected for one route because of the many benefits to result and to secure direct connection with the Bay Bridge terminal.

The terminal station for bridge trains will lie between Mission and Howard Streets, spanning across Fremont and First Streets. By installing a subway station in Fremont Street between Mission and Howard, passengers can readily transfer between the local and interurban systems. The line will run north under Fremont Street to Market, thence westerly under Market Street to Church Street where for the time being the underground tracks will be brought to the surface and connected to the existing Twin Peaks, Sunset and Church Street lines of the Municipal Railway. This route will require $2\frac{1}{2}$ miles of double track subway. (See Figure 6.)

Consideration was given to stopping this route near Valencia Street and to continuing it beyond Church Street to a connection with Twin Peaks Tunnel. To stop it near Valencia Street would not take the subway far enough out of the downtown district to entirely escape congestion and secure maximum benefit of high speed underground service. The surface grades favor constructing a ramp just east of Church Street while a surface exit between Valencia Street and Church Street is precluded by the profile. The cost of closing the gap between Church Street and the Twin Peaks Tunnel was found to be excessive in proportion to the time saved.

Transportation east of Fremont Street will continue to be given by surface cars as the construction of a subway in the filled ground of Market Street east of that point is not justified because of the excessive cost and the danger of damaging the foundations of adjacent buildings. It is also inadvisable to bring the subway tracks to the surface just





east of Fremont Street as a ramp structure would restrict the free use of Market Street and one or more cross streets.

Fast service between the Third and Townsend Streets Station of the Southern Pacific Company and the financial and shopping districts for Peninsula travelers can be secured later by extending the subway southerly under Rincon Hill from the Fremont Street Station.

The Market Street subway will be used by the cars of the present J, K, L, and N lines of the Municipal Railway and east of Van Ness Avenue the cars from the proposed Mission Street subway; thus the people of a very large portion of San Francisco will be given rapid transit down the main street of the City. This fast service will undoubtedly populate unbuilt portions of the City just as the construction of the Twin Peaks Tunnel built up the areas close to its west portal.

The removal of the Municipal Railway cars from the surface east of Church Street and joint operation with the Market Street Railway west of Church Street, will permit abandoning the outside tracks on Market Street west of Kearny and Third Streets.

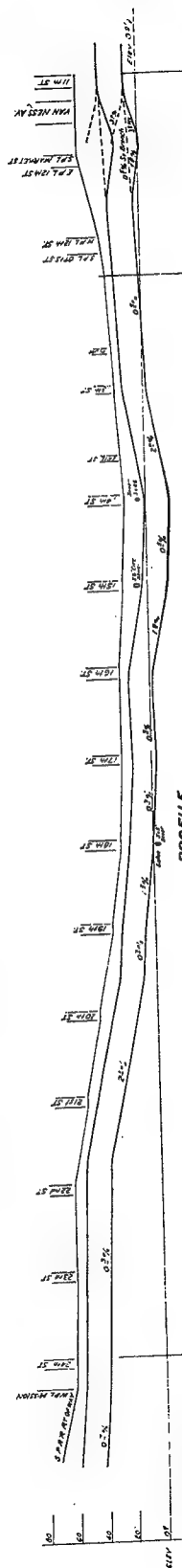
The abandonment of service on the outer tracks will open an additional automobile lane on each side of Market Street thereby doubling its present usefulness to automobile traffic through the downtown business district. This in turn will remove the necessity for detouring via the streets north of Market Street and relieve congestion in the retail center.

Mission Route—The initial Mission subway would branch from the Market Street subway at Van Ness Avenue South and extend southerly under Mission Street to Twenty-fourth Street and the Southern Pacific Company right of way which would be utilized for subway construction, to a ramp bringing the tracks to the surface in the neighborhood of Dolores and Twenty-seventh Streets. From that location they will continue on the surface over the old Southern Pacific right of way and through Bernal Cut to Monterey Boulevard. The total length from Market Street is $3\frac{1}{2}$ miles, of which 2 miles will be in subway and $1\frac{1}{2}$ miles on the surface. (See Figure 7.) The line will furnish direct service between the Mission District, downtown, and the bridge terminal, and by the addition of bus feeders, will provide fast transportation for a large present and future population.

Before selecting Mission Street the desirability of using Capp Street and Valencia Street for this line was studied. Capp Street was found to be too far to the east of the center of population of the district. A subway on Valencia Street would be closer to the center of population



MARKET AND FOURTH STREETS—SEVEN CARS HELD UP FOR ONE TO CROSS.



than one on Mission Street, but would take service from the important business street of the district. (See appendix D.) Valencia Street also carries heavy sub-surface utilities making construction expensive.

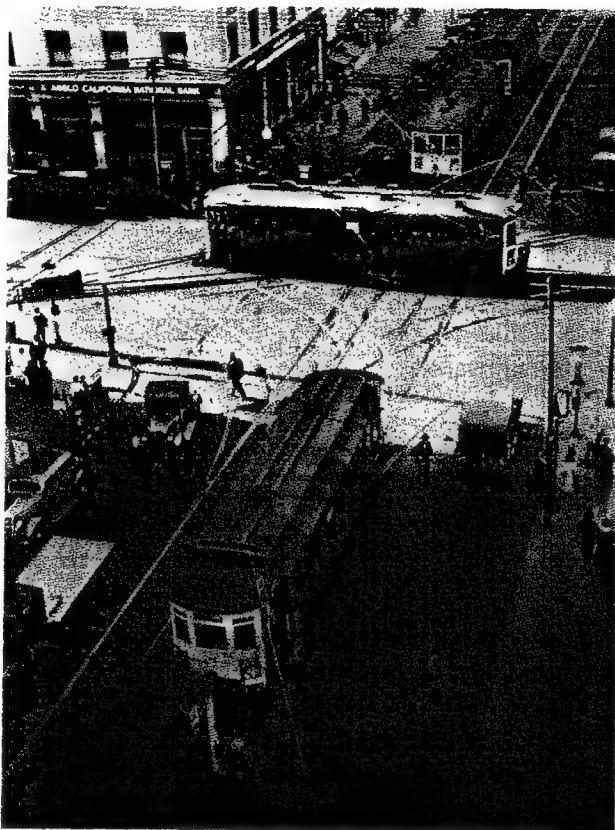
The route through the Southern Pacific right of way and Bernal Cut was selected after very careful consideration. The grades encountered prohibit readily connecting Mission Street south of Twenty-ninth Street with Bernal Cut and the Southern Pacific right of way to the south. To continue on Mission Street south of Randall Street would necessitate tunneling and prevent establishing stations, also the gulch under Mission Viaduct would have to be crossed. There are a number of unfavorable grades on Mission Street between the viaduct and the county line. To serve the Peninsula via this route would probably require subway to a point beyond Daly City.

While the Southern Pacific right of way provides the most feasible route both as to construction costs and grades, there are less attractive alternate routes. The Company has indicated that the right of way can be acquired but no price has been fixed. Should this price be unduly high, one of the alternate routes will be used. The route via the right of way will be free from level crossings and have a maximum grade of 1.7 per cent. As the right of way continues south from Monterey Boulevard it is a potential outlet for an extension into San Mateo County.

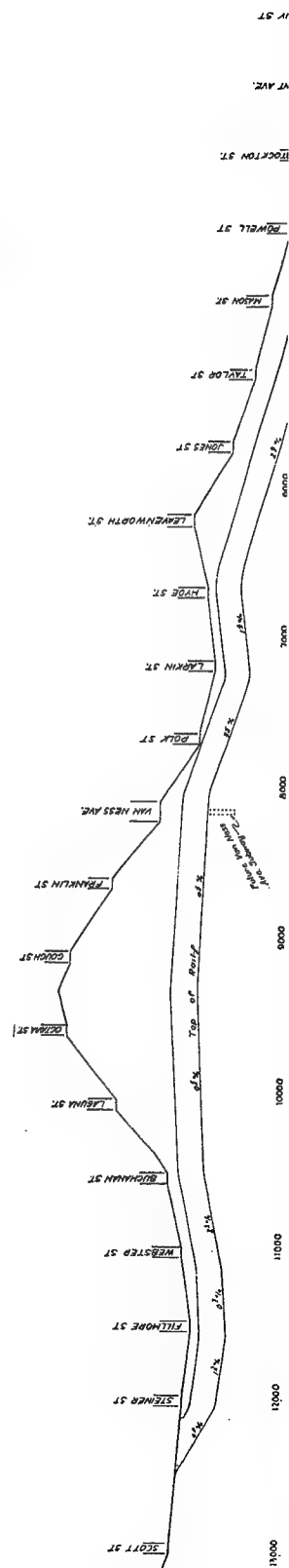
Whenever congestion in the Market Street subway makes it advisable, this line can be diverted to a new subway under Mission Street east of Van Ness Avenue South.

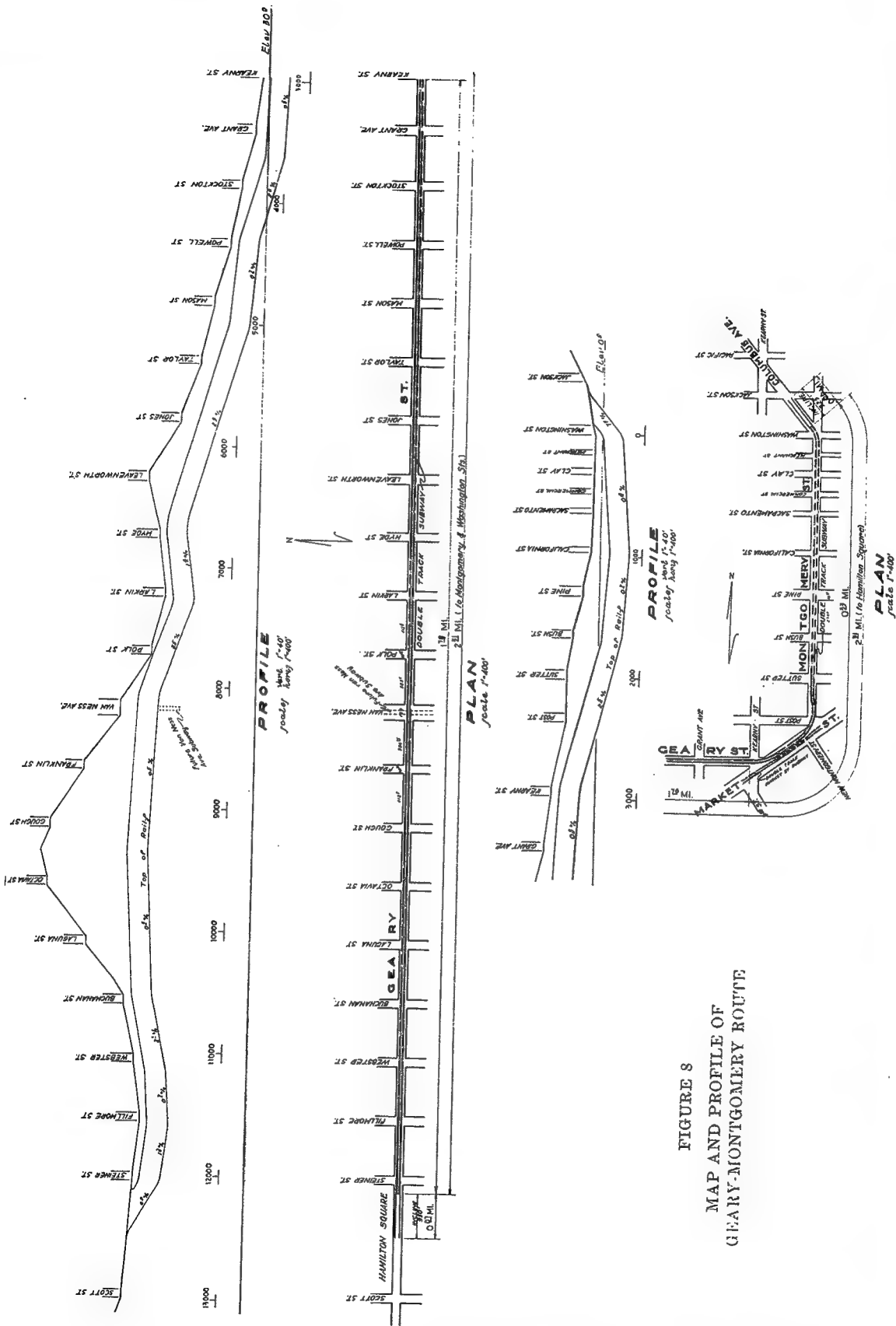
Geary-Montgomery Route—The Western Addition and the Richmond Districts house a large percentage of the City's people. The distance to the outer end of the Richmond District is so great as to require fast transportation. Geary Boulevard is approximately in the center of the Richmond District and its width and character of occupancy make it the most ideal route for the future rapid transit service north of Golden Gate Park. Geary Street is likewise the best route through the downtown district. All of the streets north of it have grades precluding the construction of stations at reasonable intervals and O'Farrell Street is too far south of the retail shops.

Ready access can be had to a subway under Geary Street from the surface at Hamilton Square near Steiner Street without blocking cross streets. From Steiner Street the subway would continue to Market Street. In Market Street between Kearny and Montgomery Streets it will parallel the Market Street Subway in such a way as to provide convenient transfer contact with the Market Street subway service. At Montgomery Street the route would turn north and after bisecting the financial district, come to the surface in Columbus Avenue which



MISSION STREET—FOUR CARS WAITING FOR ONE TO CROSS AT 16TH STREET





runs diagonally northwesterly through the populous North Beach District. (See Figure 8.) With a modification of the present plan of operation a portion of the heavily traveled F or Stockton Street line may be routed through Montgomery Street, thence out Geary Street, thus providing through service from the Marina to the Richmond District via the financial and shopping centers. This would decrease the number of cars using the present terminal at Market and Stockton Streets and relieve the congestion at this point.

When necessity demands, the proposed subway can be extended west under Geary Street from Hamilton Square. It may also be extended on the other end under Columbus Avenue to Chestnut Street thence west by tunnel and subway through the Marina District to a connection with the Golden Gate Bridge if that be found necessary.

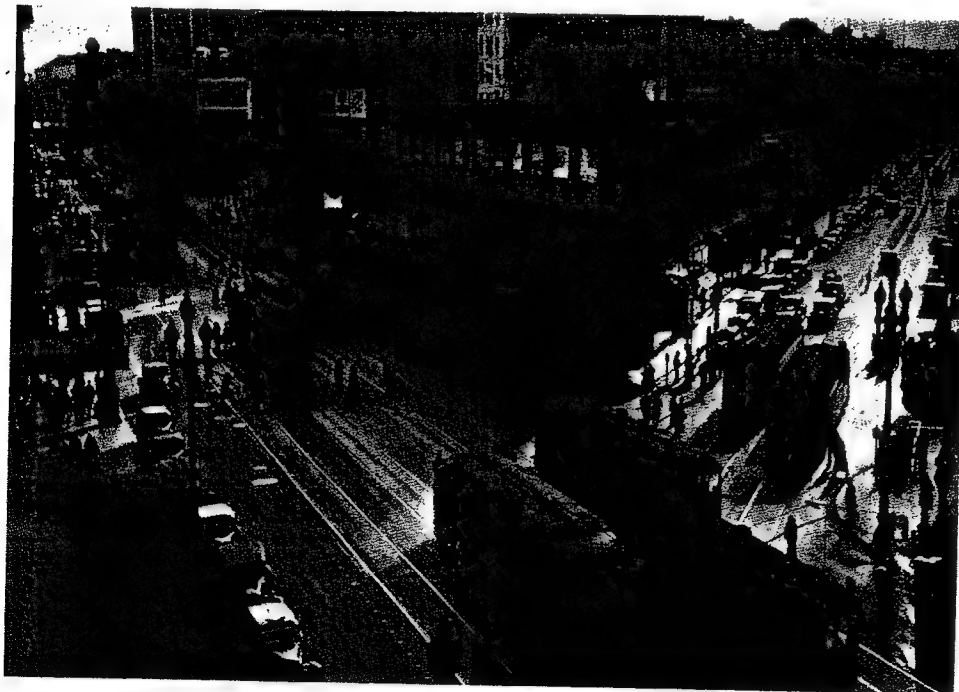
The transfer station under Market Street between Montgomery and Kearny will permit interchange of passengers between the cars of several lines using the Market and Geary-Montgomery subways and furnish quick service between the financial district and the bridge terminal. Transfer in an underground station is much more simple and convenient than transfer between surface lines.

The number of workers in the financial district warrants the construction of a direct subway line on Montgomery Street. Likewise the people of the North Beach District require ready access to the Market and Mission Street rapid transit lines.

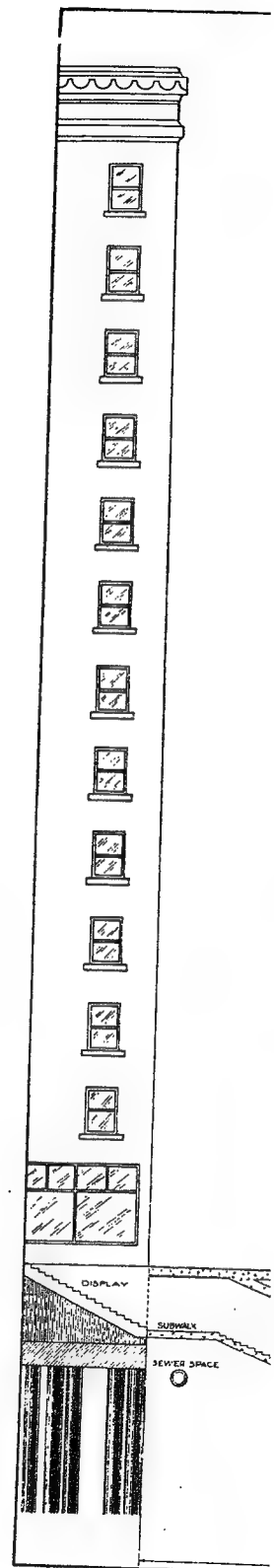
To route the Geary Street cars to the bridge terminal would serve no good purpose as the service rendered by the Market Street line will be more than ample.

STATIONS.

Underground stations will be installed at intervals averaging one-third of a mile. Those on Market Street and possibly some other locations, will be of the mezzanine type as shown in Figure 9. These have a floor between the street surface and the train platform which gives passengers the privilege of entering or leaving the station from either side of Market Street. Pedestrians desiring to cross the street may also use the mezzanine floor as an underground passage. This type of station will remove a large amount of pedestrian traffic from the



STREET CAR CONGESTION AT FIFTH AND MARKET STREETS IS EXPERIENCED EVERY EVENING.



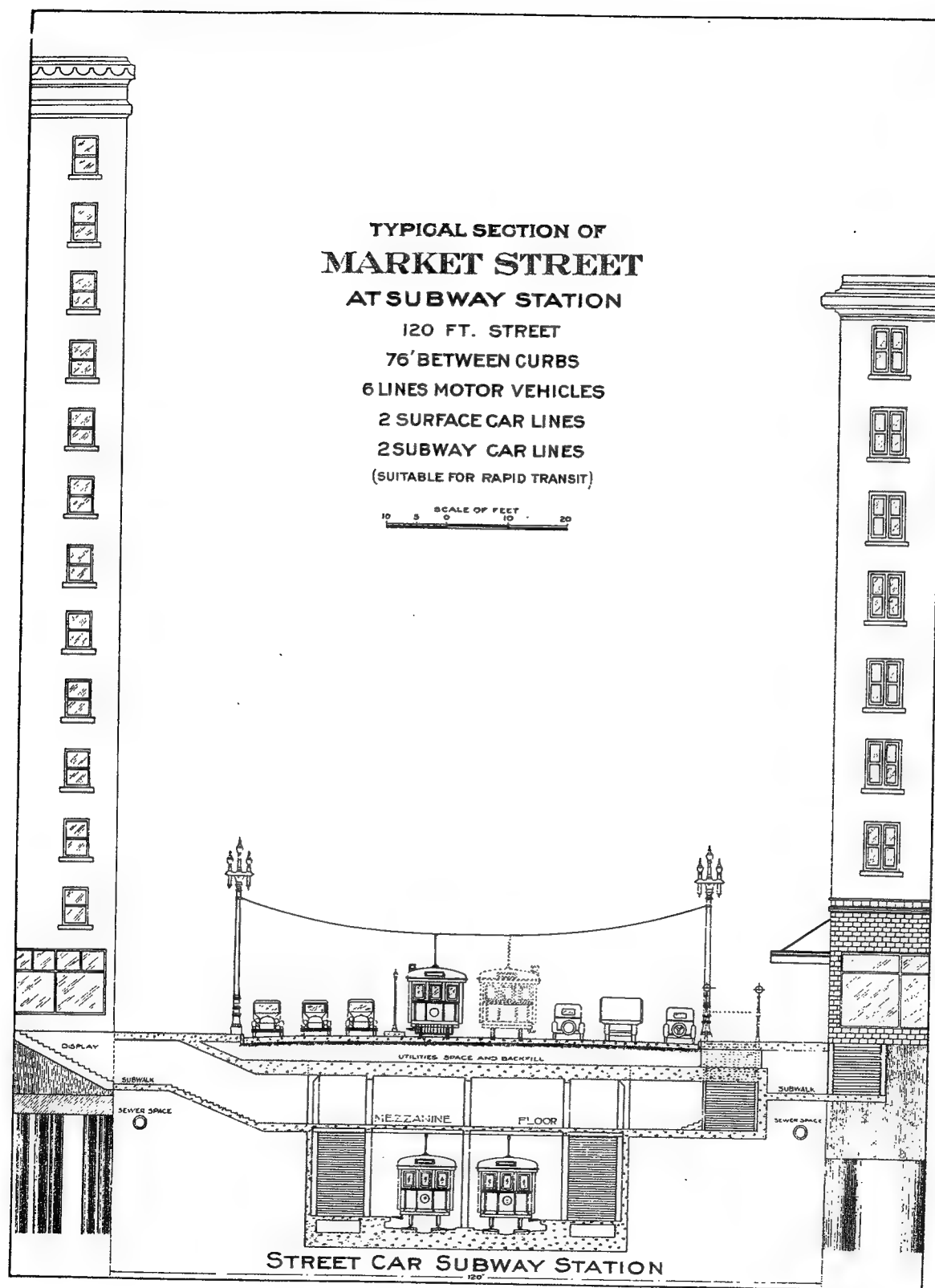
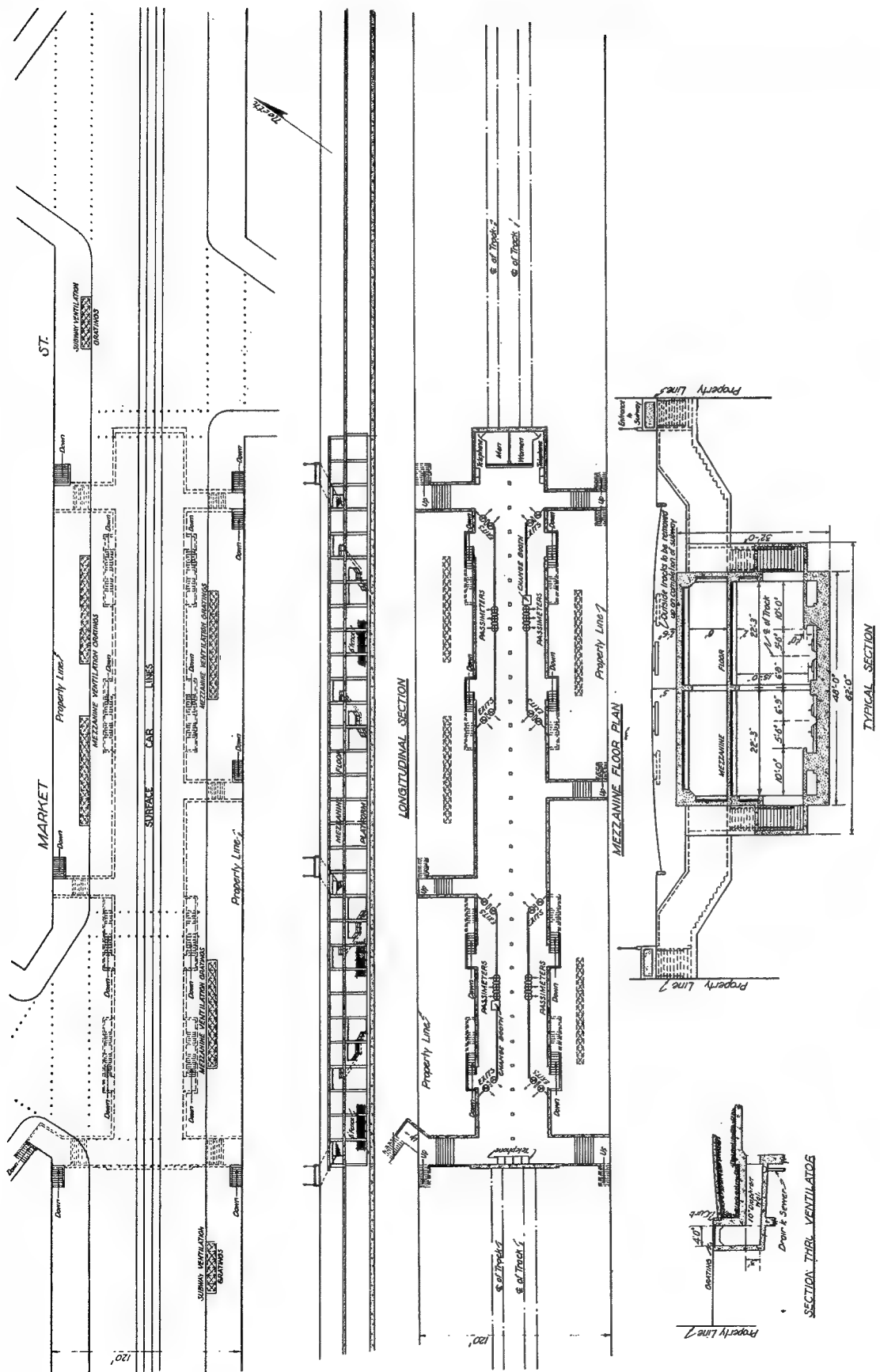


FIGURE 9

CROSS-SECTION THROUGH MARKET STREET MEZZANINE STATION
Removal of outer tracks on surface adds two lanes for vehicles. Mezzanine level may be used for passageway across street and between buildings.



TYPICAL ARRANGEMENT OF MEZZANINE STATIONS PROPOSED FOR MARKET STREET.



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MARKET AND NINTH STREETS—CONGESTION PREVENTS RUNNING ADDITIONAL CARS REQUIRING PASSENGERS TO WAIT THEIR TURN.

surface thereby promoting safety and speeding up vehicular traffic. In some stations it will be possible to provide underground show window space and direct access from the mezzanine floor to the basements of adjacent stores. The mezzanine station is admirably suited to irregular street intersections as passengers may enter the upper level at a number of different places, avoid delay from surface traffic and find shelter in rainy weather. Prepayment wickets will be installed between the mezzanine floor and the train platform eliminating any delay caused by collecting fares as passengers board the cars.

All of these features are in satisfactory use in New York City and elsewhere. Should it ever be found necessary to install a four track subway under Market Street the mezzanine type station would be essential to reach the center tracks. By including them in the original construction immediate benefits and provision for the future will be secured.

The design of the transbay bridge terminal provides for passenger ramps and stairways and for the later installation of escalators connecting the subway and interurban train platforms.

COSTS.

All the costs of the rapid transit system described above have been estimated. The amounts given below include subways, tunnels, stations, tracks, signals, changes in present cars, and the new cars required for the Mission Route; also a car barn and shop to care for the subway cars which can neither readily nor economically be housed in the present carhouses.

Consulting Engineers Ridgway and Brahdy have assisted in preparing these estimates and report them to be conservatively close to probable costs of construction.

At a number of places it will be necessary to purchase either rights of way or easements in order to carry out the work proposed. The Mission Street Route requires the acquisition of at least a portion of the Southern Pacific Company's old right of way. These right of way costs have been shown as a separate item; also the cost of interest during the period of construction.

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT

The estimated cost of the rapid transit system described herein has been summarized as follows:

1. Market Street Route.....	\$17,900,000
2. Mission Street-Bernal Cut Route.....	14,200,000
3. Geary Street-Montgomery Street Route.....	13,600,000
4. Right of Way to be Acquired.....	1,000,000
5. Interest during Construction.....	6,000,000
Total.....	\$52,700,000

Further details of these estimates are given below:

Market Street Subway:

Fremont to Gough Street, 1.86 miles.....	\$12,650,000
Tunnel, Gough to Church Streets, 0.44 miles.....	1,200,000
Fremont Street subway, .19 miles.....	2,650,000
Track, signals, electrical work, car changes, carhouse and trial operation.....	1,400,000

Total—Subway and equipment.....\$17,900,000

Mission Street Route:

11th and Market Streets to 24th and Mission, 1.64 miles.....	\$ 9,500,000
24th and Mission Sts. to Monterey Blvd. 1.89 mi. exclusive right of way.....	3,000,000
Track, signals, electrical work, cars, trial operation.....	1,700,000

Total—Subway and equipment.....\$14,200,000

Geary-Montgomery Route:

Subway, Scott to Buchanan Street, .38 miles.....	\$ 1,720,000
Tunnel, Buchanan to Van Ness Avenue, .47 miles.....	1,625,000
Subway, Van Ness to Kearny, 1.00 miles.....	5,955,000
Subway, Market and Kearny to Montgomery and Columbus Ave., .53 miles.....	3,700,000
Tracks, signals, electrical work, equipment changes and trial operation..	600,000

Total—Subway and equipment.....\$13,600,000

FINANCING.

In submitting this rapid transit construction program it is with the full knowledge that the existing five cent street carfare will not carry the heavy investment. There will be certain economies in underground operation such as a lower cost per car hour on account of higher schedule speed; freedom from the expense of maintaining pavement, trolley poles and similar surface plant. There will, however, be new expenses, namely: the maintenance and operation of subway stations, subway lighting, interlocking plants, block signals and other adjuncts to underground operation.

As there can be no question of the immense benefit to the City as a whole which will come through the establishment of a rapid transit system, it is only reasonable and just that the cost be met by general obligation bonds.

A very excellent illustration of the benefits accruing to the City as a whole by the improvement of transportation is found in the case of the west of Twin Peaks area. All of this district lying within approximately three blocks of Municipal Railway service through the Twin Peaks Tunnel has been surveyed to learn the increase in assessed value of land and improvements and the resulting increase in municipal revenue during the past twenty years, including the period of building depression. Comparative figures for 1915 and 1935 are given below:

Assessed Value	Land	Buildings	Total	Taxes
1935	\$11,307,060	\$17,500,645	\$28,807,705	\$1,060,675
1915	5,845,360	641,180	6,486,540	151,136
Increase 20 years	\$ 5,461,700	\$16,859,465	\$22,321,165	\$ 909,539

Land value
the annual amount

The Market Street
number of years
connecting station
granted in 18
slow transportation

The construction
and in February
via the tunnel
increase in value

There can
marvelous growth
already resulted

Without doubt
even now being
necessary to work
has benefited
more for all
number who
San Francisco to
and put aside
overcome any

By operation
employed in reduction
of the taxpayer
the San Francisco



MARKET

Land values nearly doubled, the investment in improvements is 27 times as great, and the annual amount collected in taxes increased to 6 times the original sum.

The Market Street Railway had been operating its existing lines into the district for a number of years and in addition, a service on Taraval Street west of 20th Avenue, and over connecting streets to 35th Avenue and Sloat Boulevard. The Ocean Avenue franchise was granted in 1879 and those for the other tracks in 1907. All of these routes furnished but slow transportation downtown and development was likewise slow.

The contract for constructing the Twin Peaks Tunnel was awarded in November 1914 and in February 1918, railway service was commenced. As the prospect of fast transportation via the tunnel gave impetus to property development it is reasonable to calculate the increase in values from 1915.

There can be no question that these rapid and direct street car lines have caused the marvelous growth of the area they serve. The tunnel cost approximately \$4,000,000 and has already resulted in increasing the taxes collected by twice this sum.

Without the Twin Peaks Tunnel the vast area now covered with beautiful homes would even now be producing cabbages and cauliflowers for whose very existence it would still be necessary to wage perennial battle against encroaching sand dunes. The Twin Peaks Tunnel has benefited one part of our City while the proposed rapid transit will do as much and more for all sections, permitting them to hold their present tenants and attract the vast number who without it will be lost to some suburban community eventually causing San Francisco to lose its supremacy. The job must be done now. It has already been discussed and put aside for too long and to wait another ten years may make it too late to fully overcome any damage which will be done in the meantime.

By operating the system as a part of the Municipal Railway, any profits may be employed in reducing the interest and redemption charges for rapid transit bonds to the relief of the taxpayers in the same manner as the profits from the Hetch Hetchy power plants and the San Francisco Water Department are now being applied. With general obligation bonds



MARKET AND TWELFTH STREETS—MORNING RUSH HOUR CARS INBOUND.

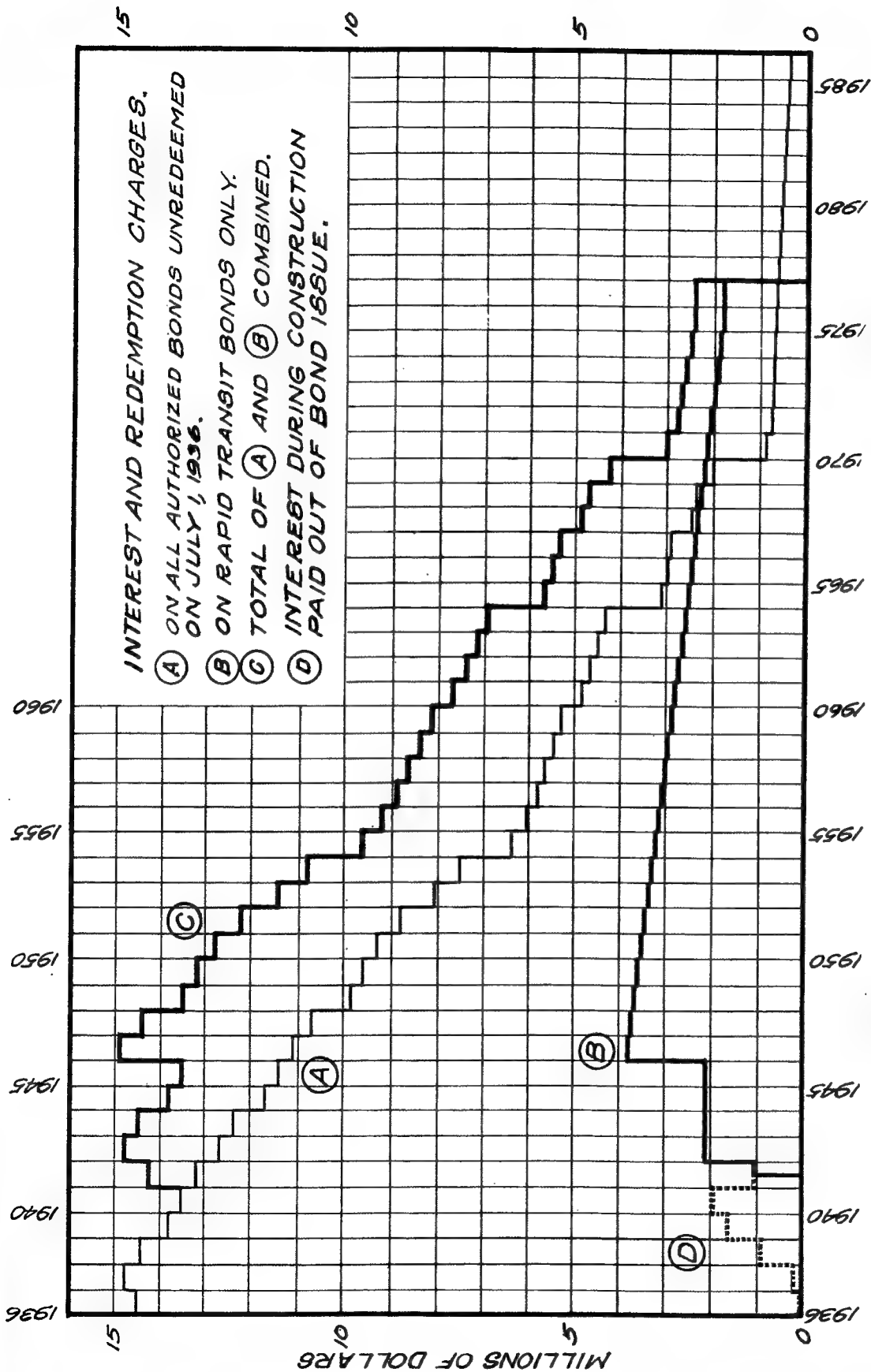


FIGURE 10—EFFECT OF RAPID TRANSIT BONDS ON CITY DEBT SERVICE CHARGES
Peak of 1946-47 Only Slightly Exceeds Present Commitment of 1937-38. Thereafter Annual Debt Charges, Including Rapid Transit are Below Those of Current Year Indicating that Program Proposed Will Not Raise Future Tax Rates.



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CAR TRAFFIC ON LOWER GEARY STREET.

the individual charges will be relatively light and everyone enjoying the benefits will participate in the cost.

The building of the subways will require five years during which period a number of present outstanding bonds will be retired. Controller Leonard S. Leavy has prepared data showing the City's obligations for bond interest and retirement for the next fifty years. The annual requirements for present bonds, for the proposed rapid transit bonds and for a combination of the two, are shown in Figure 10.

On account of the programmed retirement of existing bonds it will be possible to issue rapid transit 4 per cent forty year bonds without exceeding the present commitment for bond interest and redemption at any time in the future. Therefore San Francisco's present tax rate will not at any time suffer a large increase by reason of the investment in rapid transit herein proposed.

The reason for this can be seen by further examination

of Figure 10—during the five years, while the project is under construction, the interest will be paid from bond funds. Therefore there will be no additional bond interest carried on the tax rate until the rapid transit lines have been placed in service. As the peak requirement for interest and redemption on outstanding bonds comes in the fiscal year 1937-38, and falls rapidly thereafter, the additional interest on rapid transit bonds five years hence will not raise the maximum total requirements above that of the peak year. The retirement of rapid transit bonds need not be commenced before ten years from their issue by which time interest and retirement for present issues outstanding will have fallen to a level which will permit adding both interest and redemption charges for rapid transit without adding more than \$155,000 to our 1937-38 commitment and that for the year 1946-47 only. On the basis of our present assessment this could be covered by an increase of two cents in the tax rate.

Controller Leavy states that bonds required to carry out the proposed rapid transit program can be issued at this time without exceeding the bond limit fixed by the Charter.

At this time general obligation bonds of San Francisco can be sold at a low rate of interest.

The construction of these subways will:

1. Shorten the running time between the outlying residential and downtown districts by from 15 to 20 minutes.
2. Retain present residents by keeping local travel time under that to East Bay cities via bridge trains.
3. Increase population by building up districts which have been retarded by slow transportation.
4. Increase value of local residential property.
5. Prevent decentralization of business and stabilize downtown real estate values.
6. Remove two car tracks from Market Street west from Kearny Street.
7. Improve vehicular traffic flow downtown.
8. Furnish direct transportation to and from the financial district.
9. Provide fast and convenient service to Bay Bridge terminal.
10. Create nucleus of extended rapid transit system.
11. Build initial links for improved service to peninsula communities.

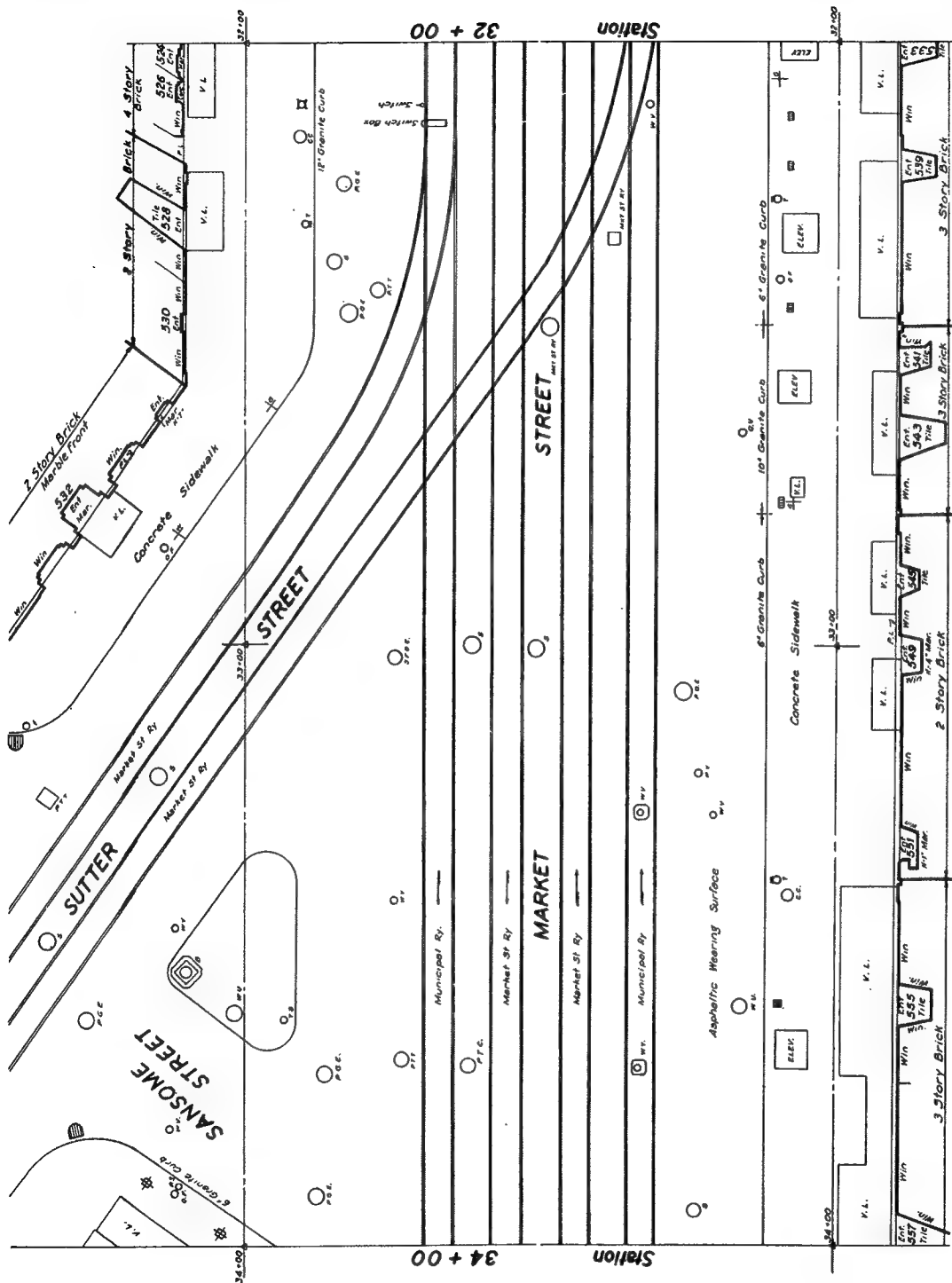
After carefully studying this important problem and discussing traffic, real estate values, and population growth with well informed and thinking citizens, I am convinced that rapid transit is essential and that construction should be undertaken immediately. Rapid transit facilities in use in Eastern cities have been examined and officials operating them interviewed and there is no question as to the use of subway as compared to elevated track. Subways under construction have been examined and there is nothing in San Francisco conditions which will prevent their satisfactory construction and use here.

1. That your Honorable Commission approve in its entirety the \$52,700,000 subway program herein outlined.

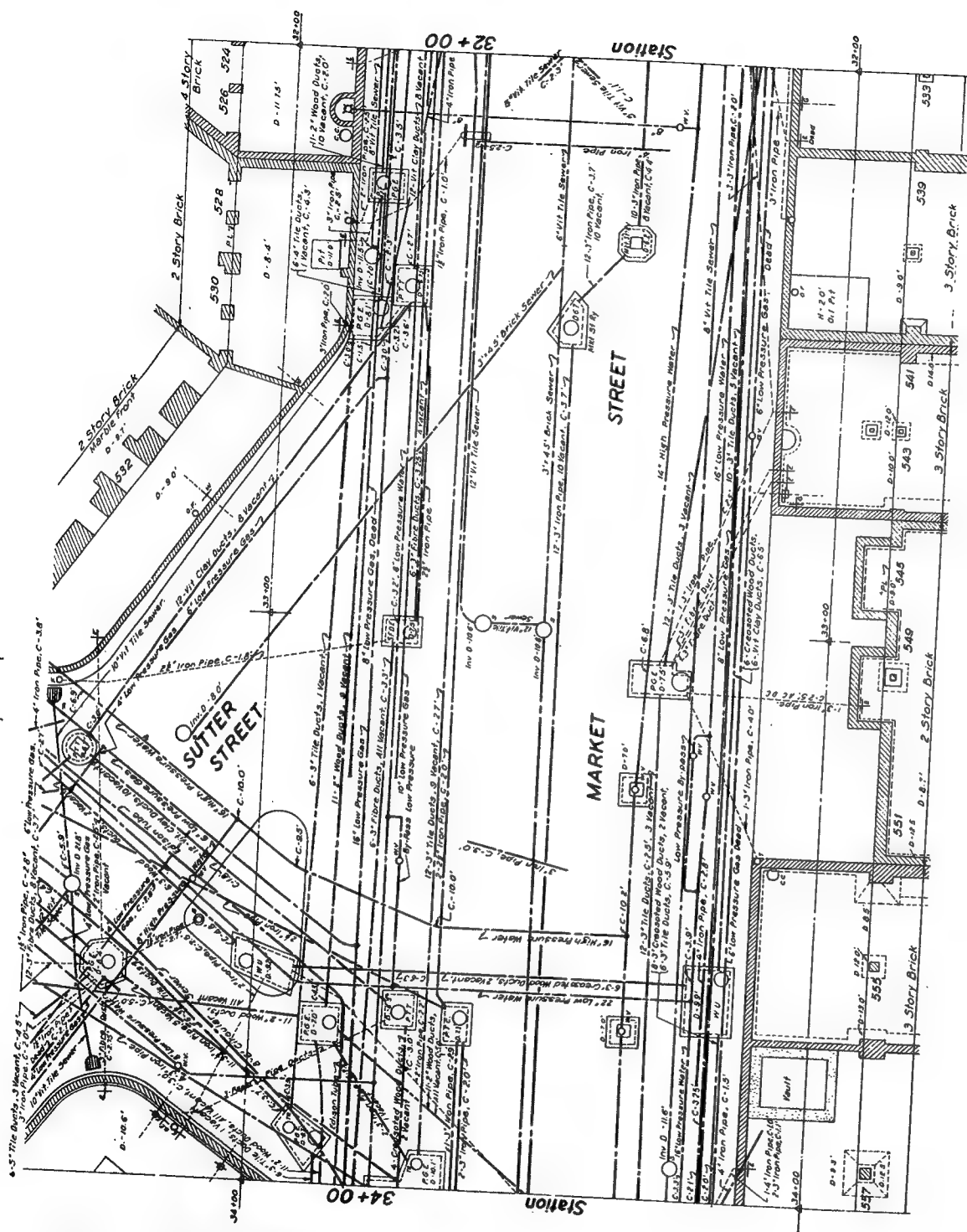
2. That the work be financed by an issue of general bonds with maturities so arranged that there will be but a slight increase in the peak requirement for debt service above that to which we are already committed.
3. That because of present traffic conditions and the probability that without local rapid transit definitely assured, San Francisco may lose considerable population, immediate action be taken to secure the authorization of the bonds necessary.

W. G. Smith
Manager of Utilities.

SECTION OF M



SECTION OF MARKET STREET SURFACE SURVEY BEING MADE BY W.P.A. FORCES.



SECTION OF MARKET STREET SUB-SURFACE SURVEY BEING MADE BY W.P.A. FORCES.

To the Honorable
Public Utilities
City and County
Gentlemen:

Based on our
rapid transit plan
neer of the Public
the City of San
8½ miles, as an

1. A Market Street
and extending north
Street where a
Peaks and Sunset
2½ miles of two
2. A Mission
Market Street from
to 24th Street, to
reaching the surface
along the surface
Boulevard. This
and 1½ miles of

3. A Geary Street
opposite Hamilton
easterly under Market
to a ramp on Colma
the subway to the
at both ramps of the

4. Connecting
are to be operated
provide convenient
latter to larger terminals

Accompanying
proposed rapid transit
surface routes, with
proposed rapid transit

ES:

The cost of construction
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trend of material prices
accepted as estimates
Estate Department.

APPENDIX

APPENDIX A

REPORT ON RAPID TRANSIT FOR SAN FRANCISCO

ROBERT RIDGWAY and ALFRED BRAHDY

Consulting Engineers of New York City

To the Honorable
Public Utilities Commission of the
City and County of San Francisco
Gentlemen:

SAN FRANCISCO RAPID TRANSIT

Based on our survey of the existing transportation facilities, an examination of the rapid transit plans prepared under the direction of Mr. Paul J. Ost, Chief Electrical Engineer of the Public Utilities Commission, and our study of the rapid transit requirements of the City of San Francisco, we recommend the construction of the following routes, totalling 8½ miles, as an "Initial Rapid Transit Subway System" for the City of San Francisco:

1. **A Market Street Route:**—Beginning near Howard Street, under Fremont Street, and extending northerly to Market Street, thence westerly under Market Street to Church Street where a ramp to the surface is to provide track connections to the existing Twin Peaks and Sunset Tunnels and to the Church Street surface car line. This route consists of 2½ miles of two-track subway.

2. **A Mission Street-Bernal Cut Route:**—Beginning as a subway at a junction with the Market Street Route near Van Ness Avenue, and extending southerly under Mission Street to 24th Street, thence under the old right of way of the Southern Pacific Co. to a ramp reaching the surface near Dolores Street and 27th Street, thence westerly and southerly along the surface of the Southern Pacific Co. right of way and the Bernal Cut to Monterey Boulevard. This route, totalling 3½ route miles, consists of two miles of two-track subway and 1½ miles of two-track surface line.

3. **A Geary Street-Montgomery Street Route:**—Beginning at a ramp in Geary Street opposite Hamilton Square and extending east under Geary Street to Market Street, thence easterly under Market Street to Montgomery Street, thence north under Montgomery Street to a ramp on Columbus Avenue near Washington Street. Suitable track connections from the subway to the existing surface lines of the Municipal Railway System are to be made at both ramps of this route. This route consists of 2½ miles of two-track subway.

4. **Connecting Bus Lines:**—In the residential sections a sufficient number of bus lines are to be operated to supplement the service of the rapid transit routes. These buses will provide convenient access to the rapid transit lines, thereby extending the benefits of the latter to larger territories.

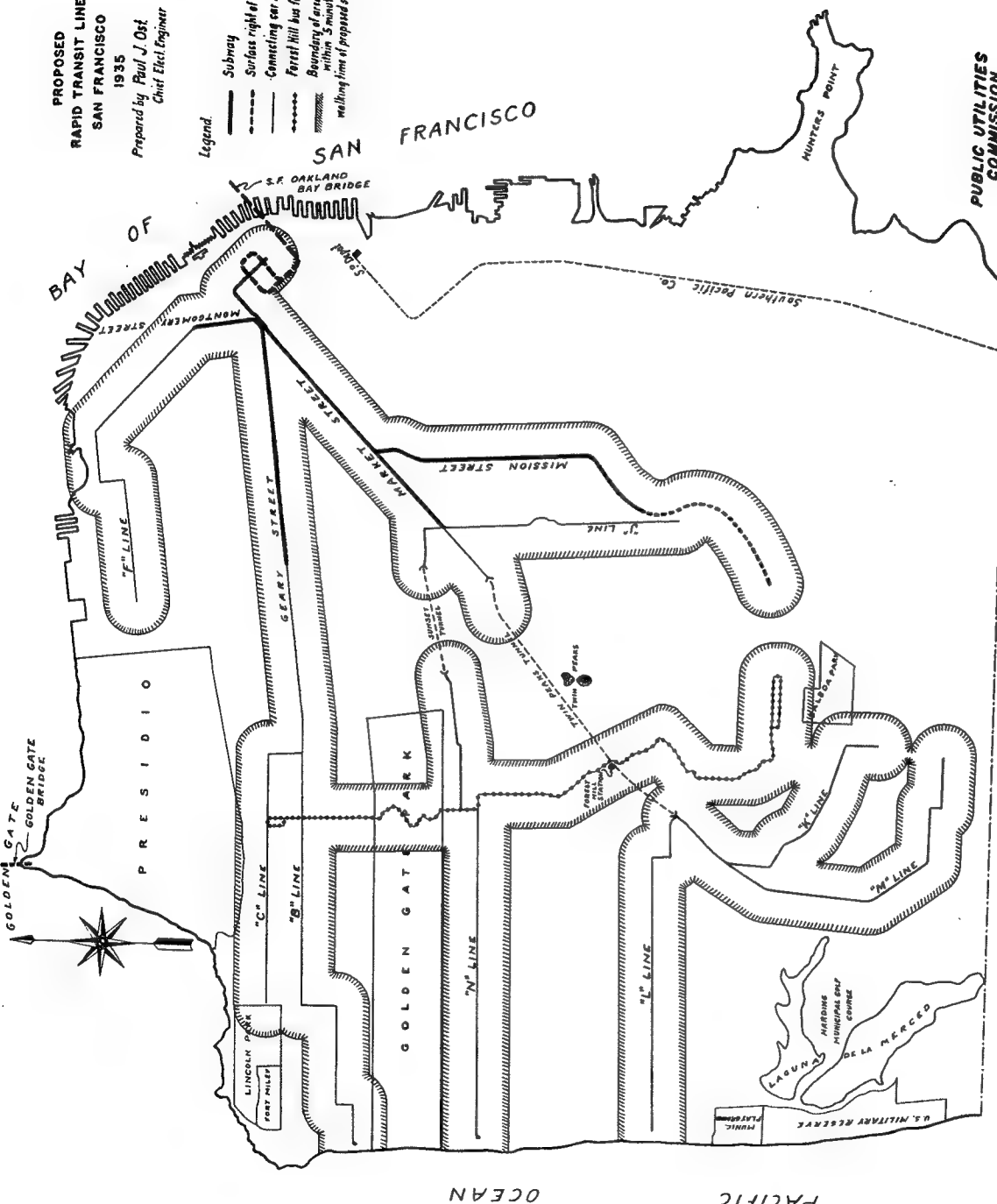
Accompanying this report are two maps of the City of San Francisco, one shows the proposed rapid transit routes and the other the subways and connecting street railway surface routes, with the areas marked which will be within five minutes walking time of the proposed rapid transit service.

ESTIMATED COST OF THE RAPID TRANSIT SYSTEM.

The cost of construction of the rapid transit system was estimated by the City Engineer, and that for equipment by the Engineers of the Public Utilities Commission. These estimates were analyzed, and in our opinion represent the cost of the work under present conditions. In analyzing the estimate, consideration was given to the uncertainty in the trend of material prices and wage rates. The cost of right of way to be acquired was accepted as estimated because this item of cost is subject to the approval of the Real Estate Department. The estimated cost of the Initial Rapid Transit Subway System is:—

PROPOSED
RAPID TRANSIT LINES
SAN FRANCISCO
1935
Prepared by Paul J. Ost
Chief Electrical Engineer

Legend:
 Subway
 Surface right of way
 Connecting car lines
 Forest Hill bus feeder
 Boundary of area
 within 5 minutes
 walking time of proposed service.



AREAS DIRECTLY BENEFITED BY PROPOSED RAPID TRANSIT ROUTES

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The above careful survey reports were studied. The conditions considered. The immediate needs of a comprehensive Greater San Francisco. The construction and laborers for labor than any other. This emphasis of the population industry by indicating existing property.

In connection with Chicago some transportation system growing; in fact, population of a number of riders longer. A satisfaction and at the same time arise from time.

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In large cities in a reasonable community by means of modern standard logical city plan transit can only surface by the city.

Elevated rail one-third the expenditure, furthermore, being medium.

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1. Market Street Route	\$17,900,000
2. Mission Street-Bernal Cut Route.....	14,200,000
3. Geary Street-Montgomery Street Route.....	13,600,000
4. Right of Way to be Acquired.....	1,000,000
5. Interest during Construction	6,000,000
TOTAL.....	\$52,700,000

The above recommended "Initial Rapid Transit Subway System" is the result of a careful survey of the City and its present local transportation facilities. Records and reports were studied to determine the present and future local transportation requirements. The conditions created by the construction of the Transbay Bridge were taken into consideration. The routes recommended for construction are, in our opinion, adequate for the immediate needs of the City and are planned so that they can be extended later to form part of a comprehensive system which will provide adequate transportation facilities for the Greater San Francisco of the future.

The construction of the subway system will provide work for thousands of mechanics and laborers for several years, as subway construction requires a larger proportion of local labor than any similar municipal improvement except highways, sewers or park developments. This employment will create increased purchasing power for a considerable portion of the population, thereby improving business conditions. It will also stimulate the building industry by inducing new commercial and residential construction and the modernization of existing properties.

NEED FOR RAPID TRANSIT IN LARGE CITIES.

In connection with the investigation of the transportation facilities of the City of Chicago some years ago, it was stated that "The greatest difficulty in developing a transportation system for a modern city is that it can never be completed, but that it is always growing; in fact, the traffic increases at a faster rate than the population of a city. If the population of a city is doubled, there are not only twice as many people to carry, but the number of rides per capita is increased and the distances that must be travelled grow longer. A satisfactory transportation plan must be based on a definite and sound theory and at the same time it must be sufficiently elastic to meet the varying conditions that arise from time to time".

The transportation system of a modern city has been likened to the arteries of a human being. If the arteries function properly the body thrives, but if they become deranged the patient sickens or dies. So with a city, if the transportation system does not adequately serve the community, the city ceases to grow and the people will go elsewhere to live or work.

In large cities where residential areas are no longer accessible from the business district in a reasonable travel time, they must be brought nearer to the center of the community by means of rapid transit. This will prevent congestion of population, promote modern standards of living in healthful surroundings, and aid in the development of a logical city plan. In the business district and in the surrounding congested areas, rapid transit can only be provided by removing the transportation facilities from the street surface by the construction of elevated railways or subways.

ELEVATED RAILWAYS.

Elevated railways have the advantage of lower first cost, as they can be built at about one-third the expense necessary to construct subways of equal length and capacity. Furthermore, being in the open air, many riders prefer them to subways as a transportation medium.

Elevated railways, however, interfere with the light, air and access of abutting property, making it less desirable for business and residential purposes, thus depreciating its value. The noise resulting from overhead train operation is objectionable to those living or working along the line. Vehicular traffic avoids streets encumbered with elevated structures, thus increasing congestion on nearby parallel thoroughfares.

Experience in New York City has shown that elevated railways have, since their construction, retarded the development of real estate along the streets where they were built. In the same neighborhood, properties along streets which were not encumbered by elevated railways have been improved with modern buildings, while properties along streets over which they are located have remained stationary or have deteriorated. That this condition was caused by the presence of the elevated railway is proven by the fact that the removal of short lengths of elevated railways in New York City has resulted in the construction of high class modern buildings and in the modernization of the remaining older buildings along these streets. As a result of these experiences the City of New York has officially banned the construction of further elevated railways.

SUBWAYS.

While the cost of constructing subways is greater than the cost of building elevated railways, their selection for rapid transit lines is warranted because they enhance the value of abutting property as well as property in the vicinity of the subway route, particularly in cross streets at stations. The streets traversed by subways are benefited by the elimination of noise inherent in the operation of surface cars or elevated railways. The community is benefited by the reduction in traffic congestion at the street surface, and by greater tax returns due to the increased value of real estate. Experience in other cities shows that subways attract business and population to the areas for which they provide rapid transit facilities.

Even though subways cannot be financially self-supporting at a reasonable rate of fare, they should be built as a civic necessity in a manner similar to schools, hospitals, governmental buildings and water supply systems, some of which are only in part income producing.

NEED FOR RAPID TRANSIT FOR SAN FRANCISCO.

The unique location of San Francisco at the head of a peninsula, the peculiar topography of the 44 square miles comprising the City, which differs from that of most other American cities, a street layout antedating the era of tall buildings and automobiles, and a constantly increasing population at present totalling about 700,000 people, to which are added about 75,000 non-residents daily entering the City, create a congestion in the business district which slows down the surface cars to such an extent that it is often possible to traverse distances faster by walking than by riding. While not readily apparent, the time and energy wasted because of street congestion represent a serious economic loss to the community. The past growth, the present day conditions, and the prospective development of San Francisco have been ably described in previous reports. These reports have already shown the necessity for rapid transit. The determination of suitable rapid transit routes and of the type of structure to provide the maximum community benefit at the lowest cost is the next essential step.

In order that San Francisco may continue to maintain its position as a commercial and financial center, it is essential that the people be provided with local transportation facilities which will enable them to reach the business district from their homes in less time than is possible from communities beyond the City limits. The rapid transit system recommended herein will accomplish that purpose.

Conditions in San Francisco do not as yet warrant such extensive and costly subway transportation systems as have been built in London, Paris, New York and Philadelphia, in which multiple unit trains are operated, entirely separated from the surface transportation facilities. The present transportation needs of the City can best be served by subways in which cars of connecting surface lines are operated until such time as the growth of population and the extension of the subway transportation system make it necessary to provide multiple unit trains. The subways recommended are to be so designed that a change from street car to train operation can readily be made.

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UNIFICATION OF THE TRANSPORTATION SYSTEMS.

Should unification of the City's surface car transportation systems be consummated, the subways recommended in this report will serve as the trunk lines for the unified system. Unification of the City's transportation facilities is desirable as it would provide a more flexible service and increase the efficiency of the entire transportation system. It would make for economies in management and operation by eliminating overlapping services, so that more and better service could be rendered without increasing the cost of operation. Services controlled by different managements cannot be operated advantageously over the same rapid transit tracks. Consequently unification would permit the routing of additional surface car lines over the recommended rapid transit system.

MIXED OPERATION.

The possibility of operating interurban trains over the tracks of the rapid transit system has been suggested. The space requirements for and operating characteristics of interurban trains are different from those of the surface cars to be operated in the subway. It is our opinion that the operation of these two different and diverse services over the same tracks is not practicable under conditions existing in San Francisco.

DISCUSSION OF THE PROPOSED SUBWAY ROUTES.

Market Street Route—A two-track subway is to be built for present requirements along Market Street, designed so that two more tracks can be added in the future when a four-track subway is required under this street.

Market Street being the most important business thoroughfare of San Francisco, may be called its axial street and into it converge many of the street car lines of the City. The downtown destination of most of the car riders however, is the territory lying north of Market Street. If a parallel street to the north were available, it would be the ideal location for a rapid transit line. The nearest available thoroughfare to the ideal transportation line is Market Street, it was therefore selected for the main subway route, and in our opinion it should be so used rather than any parallel street to the south. Furthermore, to put the rapid transit line elsewhere than Market Street, would upset the natural development of more than three-quarters of a century and seriously injure many well established businesses. If Mission Street was used for the subway instead of Market Street, it would involve an additional walk of 600 feet twice a day for most of the subway passengers, requiring time which would offset some of the advantages gained by rapid transit. Subway transportation is a commodity placed at the disposal of the public at a high cost and it can only be sold in satisfactory volume if it is offered at the locations where the public wants it.

It is desirable to provide a subway station of the Market Street Route at the railway terminal of the Transbay Bridge wherever that terminal may be located. On the assumption that it will be placed at the location known as "Plan X" it is proposed to turn the Market Street Subway tracks south under Fremont Street with a subway station located for convenient transfer of passengers to the elevated Transbay Bridge Terminal Station. This will make it possible, in the future, to extend the rapid transit tracks from the Fremont Street Subway station to the Southern Pacific Company passenger station at Third and Townsend Streets.

In case the State Department of Public Works decides to locate the railway terminal of the Transbay Bridge along the Embarcadero at or near the Ferry Building, then the Market Street Subway would have to be extended east instead of turning south under Fremont Street. Records show that the shore line of the Bay was originally at First and Market Streets so that all of the extension would be in water bearing ground which has been artificially made. Due to this and to unfavorable foundation conditions, the building of this subway extension would be very costly. That this would be so was demonstrated by the difficulties encountered in the construction of the Embarcadero Underpass in front of the Ferry Building, which not only cost a large sum of money, but consumed a great deal of time in its construction.

We have considered the possibilities of operating the subway cars on the surface east of First Street. To do this would require a ramp from the subway to the surface with grades to suit surface car operation in the downtown section. Doing so would place an open well approximately 350 feet long and about 30 feet wide in the center of Market Street, reducing the traffic capacity of the street and presenting a barrier to all cross traffic at this location. Train operation, in the future, would not be practicable via this ramp, so that a costly extension of the Market Street subway is the proper means of providing rapid transit at the railway terminal of the Transbay Bridge, if it be located on the Embarcadero.

Market Street between Fremont Street and the Embarcadero will continue to be served by surface cars as at present, after the subways have been built.

At the westerly end of the Market Street Subway near Church Street the tracks will be brought to the surface by a ramp. By stopping the subway at this point, the Church Street "J" Line, the Twin Peaks "K" and "L" Lines and the Sunset "N" Line can be connected with the subway by rearranging the surface car tracks. Extending the proposed Market Street Route to provide a subway connection to the Twin Peaks Tunnel would reduce the travel time for the patrons of the "K" and "L" Lines by less than one minute, and this would require that provision be made to take the "J" and "N" Lines into the subway via other ramps. The cost of building such a connection is about \$3,000,000 which expenditure is not warranted at the present time by the resulting reduction in travel time. The Church Street ramp should be designed so as to permit extending the subway to connect with the Twin Peaks Tunnel in the future.

The construction of the subway will result in removing the two outer tracks on Market Street between Kearny and Church Streets. The use of the two middle tracks on Market Street between Church and Castro Streets, by both Municipal and Company cars will permit the removal of the two outer tracks along this portion of the street. The change from four to two surface tracks on Market Street west of Church Street will eliminate much of the present interference between automobile and street car traffic at Castro Street.

The removal of the outer pair of surface car tracks on Market Street from Kearny to Castro Streets will provide room for two additional vehicle lanes, thus materially improving traffic conditions on this important thoroughfare.

Mission Street-Bernal Cut Route—This two-track subway and surface route connects with the Market Street Subway at Van Ness Avenue, the outbound track being depressed to avoid a grade crossing with the Market Street tracks. This subway will extend under Mission Street to the old right of way of the Southern Pacific Co. near 24th Street. The subway continues under this right of way to the neighborhood of Dolores and 27th Streets, where the tracks reach the surface by a ramp; then they continue on the surface over the old right of way of the Southern Pacific Co. and through the Bernal Cut to a terminal near Monterey Boulevard. For operation beyond the terminal and from some stations along this route the use of buses is recommended to extend the benefits of rapid transit into adjacent territories.

The route extending from 24th Street to Monterey Boulevard over the old right of way of the Southern Pacific is recommended because of its favorable grades and because it costs less than any other line that can be built to serve this territory. It also opens a new residential section for development. If the right of way cannot be acquired at a reasonable cost, alternative routes are available. Mission Street is one of these alternative routes, in spite of its disadvantageous grades and the facts that the rapid transit service would overlap that now being furnished by a surface railway line.

When the traffic on the Mission Street-Bernal Cut Route develops to such proportions that the capacity of the tracks on lower Market Street, to which it connects, is reached, it will be desirable to separate the tracks of this route from the downtown portion of the Market Street Route and extend same through the business district via an additional subway under Mission Street.

Geary Street-Montgomery Street Route—The two-track subway under Geary Street extends from Hamilton Square to Market Street, thence easterly under Market Street to Montgomery Street, thence northerly under Montgomery Street to an incline or ramp near Columbus Avenue and Washington Street.

At Hamilton Square and Cal Street, or more additional ramp. At the Columbus Avenue

Geary Street is an important business and the President's financial passing Third

A subway permit convenient

The subway be built of standard gauges adapted

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At Hamilton Square a ramp will bring the surface tracks of the Geary Street "B" Line and California Street "C" Line into the subway. If unification is consummated, one or more additional surface car lines may be connected with the rapid transit system via this ramp. At the Columbus Avenue ramp connections are made with the surface tracks on Columbus Avenue over which some of the "F" Line cars may be operated.

Geary Street is recommended for the subway route because the lower part of it is an important business street while the westerly portion is midway between Golden Gate Park and the Presidio Reservation. Montgomery Street is recommended because it passes through the financial district which is the destination of the majority of the inbound passengers passing Third and Market Streets.

A subway station under Market Street between Geary and Montgomery Streets will permit convenient transfer between all routes of the recommended rapid transit system.

RAPID TRANSIT SUBWAY STRUCTURES.

The subway structures required for the rapid transit system herein recommended are to be built of structural steel and reinforced concrete according to the latest engineering standards adapted to the conditions encountered in the City of San Francisco.

The experience of other cities with the construction of subways has proven that they can be built without disturbing the normal use of the street for surface traffic or interfere with access to abutting buildings. To accomplish this the existing street pavement is removed and replaced by heavy plank decking, under which all excavating and construction work is carried on. The decking is supported to a plane below the bottom of the subway excavation and it remains in place until the construction work is completed. Water pipes, electric light and power wires, telephone cables and sewers will be supported from the decking structure during excavation, so that these essential services will not be interrupted. The existing underground gas pipes will be temporarily replaced by pipes above the street surface in order to insure maximum safety during construction. Street car tracks, lamp posts, fire alarm boxes, traffic signals and all other surface structures will be supported on the decking at their present locations. Upon completion of the underground work a new pavement will be laid on the street surface.

The stations are to be so located as to insure the most advantageous operation and to serve the convenience of the greatest number of passengers. The stations are to be roomy, well proportioned and pleasing in appearance, with the train platforms of sufficient width so that when multiple unit trains are operated in the subway there will be no crowding on the platforms or other portions of the subway stations.

It is recommended that the downtown stations of the Market Street Route be built with mezzanines above the trackways and platforms. These mezzanines will provide direct access from either side of Market Street and from the intersecting cross streets to both the in and outbound train platforms so that rapid transit passengers will not be delayed by having to cross the street surface traffic. The mezzanines can also be arranged so that they can be used as underpasses by pedestrians, thereby providing an additional means of crossing Market Street, and decreasing interference with surface traffic. In our opinion, the cost of providing the mezzanine type rapid transit stations along lower Market Street is warranted by the existing congestion at the street surface and by the large number of passengers that will use these subway stations.

The piston action of the subway cars will insure an adequate supply of constantly renewed fresh air for the comfort of the subway passengers. Emergency exits leading to the street surface are to be provided between stations so that prompt exit from or access to the subway can be had, should that become necessary. The subway will be waterproofed in accordance with the best known methods, but some water will find its way into it, mostly at stairways and ramps. A drainage system served by automatic pumps will quickly dispose of such water as finds its way into the subway and maintain it in a sanitary condition at all times.

RAPID TRANSIT FOR SAN FRANCISCO—A REPORT

SIGNALS AND ELECTRICAL EQUIPMENT.

Block signals should be provided in order that fast transportation service can be had with maximum safety. The electric current for lighting the subway stations and the trackways between stations should be obtained from several sources, so that the failure of one supply will not darken any part of the subway.

CARS AND BUSES.

The cars of the Municipal Railway System are roomy, substantially constructed and maintained in excellent condition. These cars have been operating satisfactorily for years through the two-mile long Twin Peaks Tunnel under conditions similar to subway operation. By making certain recommended changes in these cars and their equipment, they will be made suitable for use in the subway. New cars to be purchased should be designed especially for subway transportation use and should be provided as rapidly as conditions permit.

A sufficient number of buses or trolley buses are to be purchased for use as an auxiliary service to the rapid transit lines in residential sections, where the amount of traffic does not yet warrant the cost of providing rail transportation.

STORAGE AND MAINTENANCE OF CARS AND BUSES.

Storage space, with a car barn and repair shop, is to be provided for the maintenance, inspection and repair of the cars and buses of the rapid transit system which cannot readily be accommodated with the present facilities. These facilities will permit the efficient maintenance of all rolling stock in first class condition and insure uninterrupted rapid transit service.

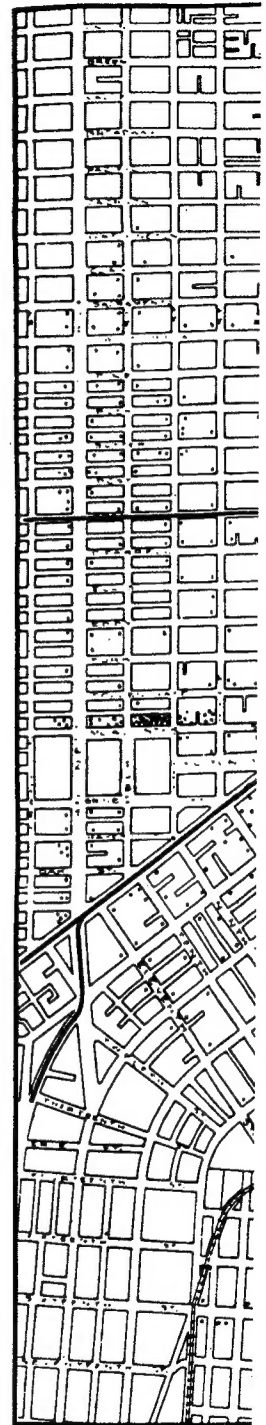
ACKNOWLEDGMENT.

Plans, estimates and data prepared by the Engineers of the Public Utilities Commission and by the City Engineer, have greatly facilitated our work. A great deal of time was saved by the active wholehearted cooperation of Mr. Edward G. Cahill, Manager of Utilities, and by the members of his engineering staff. We are particularly indebted to Mr. Paul J. Ost, Chief Electrical Engineer, and Mr. L. M. Perrin, Electrical Engineer, who gave freely of their time to us and whose intimate knowledge of the San Francisco transportation situation made it possible to complete this report in such a short time. The routes recommended are substantially the same as those which have been suggested by Mr. Ost. The data contained in the report on "Rapid Transit Plans for the City of San Francisco", prepared in 1931 by the late M. M. O'Shaughnessy, then City Engineer, was of value in arriving at the recommendations set forth herein.

Gov. Ridgway
Consulting Engineer.

Alfred Brady
Consulting Engineer.

San Francisco, California,
Dated, July 9, 1935.



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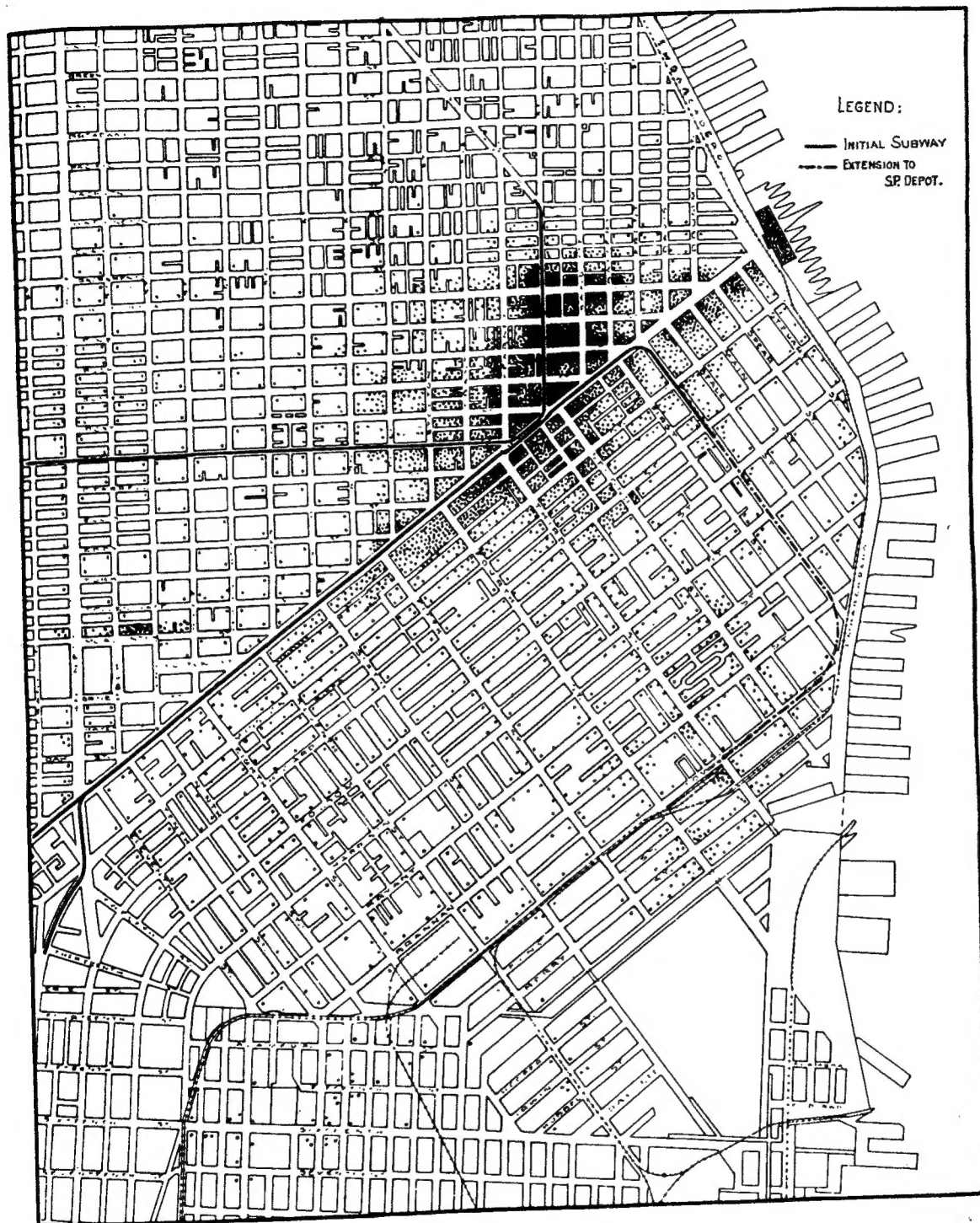


FIGURE 11

DESTINATION MAP OF PENINSULA COMMUTERS

Each dot represents one person. From survey by San Mateo County Planning Commission.

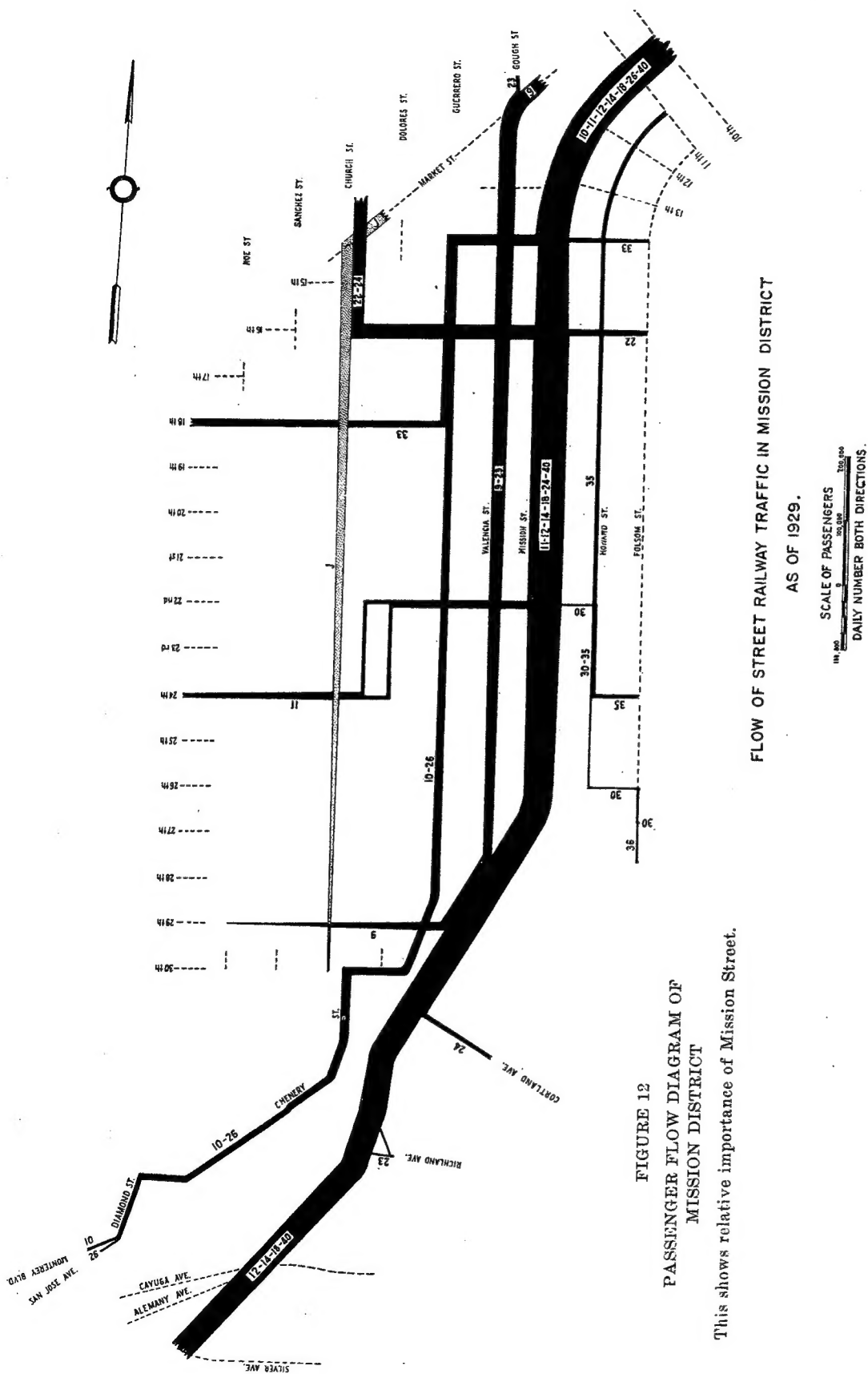


FIGURE 12
PASSENGER FLOW DIAGRAM OF
MISSION DISTRICT

This shows relative importance of Mission Street.

FLOW OF STREET RAILWAY TRAFFIC IN MISSION DISTRICT
AS OF 1929.

SCALE OF PASSENGERS
DAILY NUMBER BOTH DIRECTIONS

Interurban

Year

- 1925
- 1926
- 1927
- 1928
- 1929
- 1930
- 1931
- 1932
- 1933
- 1934
- 1935

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INTERURBAN TRAFFIC

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APPENDIX B

Interurban Rail and Ferry Passengers Entering San Francisco by years from 1925.
The table does not include passengers in automobiles.

Year	Marin County	Alameda County		San Mateo County
		Interurban	Main Line and Ferry Only	
1925	6,401,741	39,670,786	1,861,422	—
1926	6,236,216	37,126,923	1,821,648	—
1927	6,046,578	36,496,216	1,778,437	—
1928	6,473,309	35,392,401	1,691,284	—
1929	6,442,714	34,123,542	1,723,908	5,660,000
1930	5,702,427	32,786,414	1,620,200	5,274,800
1931	5,190,213	30,254,707	1,616,608	5,147,400
1932	4,984,646	26,814,187	1,286,919	4,423,300
1933	4,438,297	24,663,502	1,309,098	4,408,300
1934	4,200,240	24,718,852	1,308,502	4,450,000
1935	4,100,000	25,705,438	1,532,456	—

APPENDIX C

Figure 11, prepared by the San Mateo County Planning Commission shows by dots the San Francisco destinations of Southern Pacific peninsula train passengers. Attention is called to the large number going into the financial district adjacent to Montgomery Street. The same distribution of passengers will apply closely to those coming from the east side of the Bay.

APPENDIX D

Figure 12 shows the passenger flow on the street car lines running through the Mission District. The width of the line has been drawn to scale to indicate the average number of passengers per day. Mission Street is by far the heaviest traveled street. The large number shown on the cars on Mission Street south of the business district is indicative of the fact that many passengers are bound to or from points outside the area covered by the drawing. Some of the business shown is known to originate in San Mateo County.

